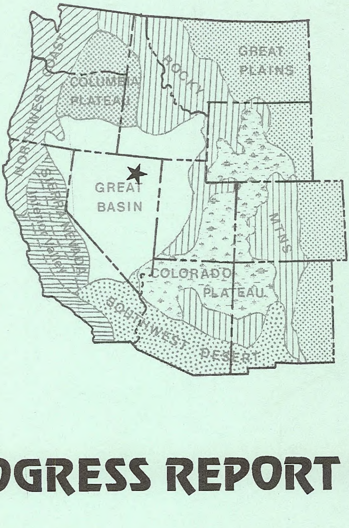
Saval Ranch Research and Evaluation Project



PROGRESS REPORT 1984

May 1985

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
NEVADA STATE OFFICE
300 Booth Street
P.O. Box 12000
Reno, Nevada 89520

IN REPLY REFER TO:
1702
(NV-930.3)

August 22, 1985

Information Bulletin No. NV-85-135

To: District Managers, Nevada

From: State Director, Nevada

Subject: Saval Project Research Report

Enclosed for your information and use, is a copy of the Annual Progress Report for the Saval Ranch Research Project. If you have any questions about the research underway on the Saval Project or would like additional copies of the Annual Report, please contact the Project Manager, Peter Lent, at FTS 470-5572 or 702-784-5572.

1 Enclosure
Encl. 1 - Annual Progress Report for the Saval Ranch Research Project

Distribution

Director (220)	1	Rm 909, Premier Bldg
Director (102)	1	Rm 5646, Interior Bldg
Director (200)	1	Rm 5654, Interior Bldg
Director (201)	1	Rm 906, Premier Bldg
SCD (D-245A)	1	
SCD (D-470)	1	
DM (CA-020)	1	
SD (ID-930)	1	
SD (UT-930)	1	
SD (OR-930)	1	
SD (CA-930)	1	

PROGRESS REPORT FOR 1984

SAVAL RANCH RESEARCH AND EVALUATION PROJECT

Editor

Peter C. Lent
Bureau of Land Management
Renewable Resource Center
920 Valley Road
Reno, NV 89512

Unpublished and Preliminary Information

May 1985

EXECUTIVE COMMITTEE

SAVAL RESEARCH AND EVALUATION PROJECT

Mr. Edward F. Spang (Chairman)
Nevada State Director
Bureau of Land Management
Reno, Nevada

Mrs. Jeanne Edwards
Saval Ranching Co.
240 Westerly Road
Weston, Mass. 02193

Dr. Bernard M. Jones
Dean and Director
College of Agriculture
University of Nevada, Reno, 89557

Dr. R. Duane Lloyd
Assistant Station Director
U.S. Forest Service
Intermountain Station
507 25th Street
Ogden, Utah 84401

Dr. Jan van Schilfgaarde
Area Director, Mountain States
Agricultural Research Service
2625 Redwing Road, Suite #350
Fort Collins, CO 80526

Mr. Gerald Thola
Nevada State Conservationist
Soil Conservation Service
P.O. Box 4850
Reno, Nevada 89505

Project Manager and Secretary to the Executive Committee:

Dr. Peter C. Lent

CONTRIBUTORS

Gary N. Back	Dept. of Range, Wildlife and Forestry University of Nevada, Reno*
John Barber	Dept. of Range, Wildlife and Forestry University of Nevada, Reno*
Mack R. Barrington	Dept. of Range, Wildlife and Forestry University of Nevada, Reno*
Verle Bohman	Dept. of Animal Science University of Nevada, Reno
Carolyn Bohn	Dept. of Range, Wildlife and Forestry University of Nevada, Reno*
David Brown	Dept. of Animal Science University of Nevada, Reno
Keith Cooley	Agricultural Research Service Boise, Idaho
Richard E. Eckert, Jr.	Agricultural Research Service University of Nevada, Reno
Karl Gebhardt	Idaho State Office Bureau of Land Management
Donald A. Klebenow	Dept. of Range, Wildlife and Forestry University of Nevada, Reno
Peter C. Lent	Nevada State Office Bureau of Land Management
J. Kent McAdoo	Dept. of Range, Wildlife and Forestry University of Nevada, Reno*
Tom Morrell	Dept. of Range, Wildlife and Forestry University of Nevada, Reno
Julie Morrow	Dept. of Animal Science University of Nevada, Reno

* Stationed in Elko, Nevada

CONTRIBUTORS (continued)

William S. Platts	Forestry Sciences Laboratory U.S. Forest Service Boise, Idaho
Mike Rule	Dept. of Range, Wildlife and Forestry University of Nevada, Reno
Charles F. Speth	Dept. of Animal Science University of Nevada, Reno
D. Waive Stager	Agricultural Research Service Elko, Nevada
R. J. Torquemada	Forestry Sciences Laboratory U.S. Forest Service Boise, Idaho

HIGHLIGHTS

OF

1984

PUBLICATIONS

Seven publications are listed as Saval Project contributions. Three of these are in press (page 3). Five other publications based solely or in part on Saval Project data are also reported (page 4).

PROFESSIONAL ACTIVITIES

Eleven presentations were given by Saval Project personnel in 1984. Four site tours were conducted.

CLIMATOLOGY

A basis for extrapolating annual precipitation data to any location on the ranch is presented. Wind data for Station 2 have been analyzed. Results from station use presented in graphic form (wind roses). An example is given of use of climatological data to normalize vegetative growth from year to year.

HYDROLOGY

Down-cutting processes in Gance and Mahala Creeks have been measured and compared. Channel changes over the past six years are depicted graphically. Four erosion plots were installed in 1984.

VEGETATION

Success of the Lower Sheep Creek Seeding has improved since 1982. In Middle Mahala Pasture, little change in frequencies of occurrence of grasses and shrubs was found between 1981 and 1984. However, frequencies of forbs were generally higher in 1984, probably due to more growing season moisture.

Grazing use of seeded pastures was 60-65% during spring 1984. Use was slight to moderate on range sites in BLM native pastures grazed during June. In National Forest pastures, grazing use was heavy on wet meadows and slight to light on most other range sites.

Seed production, seed quality, and seedling emergence components of secondary succession were evaluated. On lower elevation range sites, increaser species produced much more seed with higher germination than did decreaser species. This suggests a seed reservoir that is adequate to perpetuate these species when environmental conditions are favorable. The quantity and quality of seed of decreaser species suggest a seed reservoir that is not adequate to increase the density of the species. On higher elevation sites most decreaser species also showed good seed production and germination characteristics.

Good seedling emergence in spring 1984 resulted from a fall 1983 seeding. Most emergence occurred on coppice soil. Crested wheatgrass and Thurber needlegrass had the best seedling survival through summer 1984. A study was initiated to test seedling emergence in response to high, medium, and low amounts of simulated precipitation each week. Crested wheatgrass had the best response to coppice soil, sagebrush removal and added water equal to the highest probability of weekly precipitation.

SAGE GROUSE

The decline in estimated number of males on strutting grounds continued. Winter habitat use studies have continued and manuscripts of proposed publications are in preparation. The vegetation map for all BLM lands has now been completed and disseminated.

MULE DEER

Preliminary results demonstrate an effect of cattle grazing on subsequent mule deer diet. Forb use was affected and also changed with season.

Diets of tamed deer studied in 1982 and 1983 have been ascertained using bite counts. Shrubs accounted for about three-fourths of diet in both years. Grasses made up only 2% of the diets; Elymus cinereus accounted for about half of this. Significant shifts over time in habitat selection were described.

NON-GAME WILDLIFE

Several manuscripts for publication on small mammal studies are summarized. Continued field work on riparian bird communities further confirms the association of a species guild with high shrub canopy cover along Mahala Creek. A different array of species are closely associated with the closed canopy stands of willows along Gance Creek.

FISHERIES

The study documented major changes in streambanks, channel morphology, riparian conditions and fisheries habitat as a result of extremely high runoff events in 1983 and 1984. However, fish habitat and cutthroat trout populations continue to improve in the protected grazing exclosure.

LIVESTOCK

The thesis on cattle behavior by Julie Morrow has been completed and approved by the University. Copies have been distributed.

Cows showed rapid weight gain (1.62 lbs/day) during the 48 day period starting May 23, subsequently they maintained weight overall through December. Initial blood analyses suggest marginal plasma levels of copper and zinc in the ranch cattle.

DATA MANAGEMENT and REMOTE SENSING

Major additions have been made to central data files, particularly in vegetation, climatology, hydrology and mule deer subject areas.

Approximately 13 miles of riparian zone on the Saval Allotment were photographed in 1984 providing excellent color-infrared coverage.

TABLE OF CONTENTS

INTRODUCTION

The Saval Ranch Research and Evaluation Project was initiated in May, 1978. The overall objective is to evaluate the effects of livestock grazing management systems and range improvement practices on livestock production, vegetation, fish and wildlife and their habitat, watershed hydrology, water quality, economic factors, and other resource values.

The Project is conducted on the Saval Ranch, a privately owned enterprise located in northeastern Nevada. The ranch, livestock and grazing allotment are made available for this interdisciplinary study by the Saval Ranching Company. The allotment contains 49,105 acres; 7,557 acres are privately owned, 25,900 acres are managed by the Bureau of Land Management, and 15,600 acres are managed by the Forest Service.

Funding and support are provided by the Bureau of Land Management, U.S. Forest Service, Agricultural Research Service, and Agricultural Experiment Station, University of Nevada, Reno.

In general, this progress report describes the project activities and results of scientific investigations for the period October 1, 1983 through September 30, 1984. In addition, some analyses of data collected in past years, but not previously available, are included.

A new Memorandum of Understanding for the Saval Project came into effect on November 15, 1983. This Memorandum of Understanding established a policy-setting Executive Committee, a Scientific Team, a local Operations Team and an Advisory Committee. The position of Project Manager was also created. Minutes of the last two Executive Committee meetings are shown in Appendix I.

Common names of plants and animals are used in this report. Scientific names are given in Appendix II. The English system of measurement is also used. Factors to convert these measurements to metric units are presented in Appendix III.

The scientific results and conclusions reported here are to be considered unpublished and preliminary in nature. They are presented to meet contractual agreements and to provide the supporting agencies and parties with a basis for judging progress. No results should be cited or quoted without permission from the authors.

ACKNOWLEDGEMENTS

Once again Saval Project investigators depended heavily in 1984 on the excellent assistance provided by Student Conservation Association volunteers. The 1984 volunteers, provided through an agreement between the Association and the Bureau of Land Management, were Carole Hallett, Alf Haukenes, Alicia Lafever, Jennifer Putscher, Ruth Ann Rusin, Susan Schiffert and Bea Treiterer. Temporary employees assisting on the project included Mark Ports, Brad Rust, Patti Slaton and Martha Summers.

The period from late 1984 through the first part of 1985 was one of great personnel changes. The long association of Mark Barrington and Terry Dailey with the Project came to an end. Their past services are deeply appreciated. Allen Torell completed his Ph.D. program at Utah State and accepted a position at New Mexico State. His involvement is also missed, as is that of Ron Torell, whose short employment with the Project ended in November. At the end of the year, John Barber left to continue graduate studies and early in 1985 Kent McAdoo accepted a new position. To all the above, we wish them well and express thanks for past efforts.

Carolyn Bohn accepted employment in Elko early in 1985, filling the position vacated by John Barber. She came from a U.S. Forest Service project in John Day, Oregon and has a B.A. degree in Zoology from the University of Washington and an M.S. in Rangeland Resources and Watershed Science from Oregon State University.

CONTRIBUTIONS OF THE SAVAL RANCH

RESEARCH AND EVALUATION PROJECT[1]

McAdoo, J. K. and D. A. Klebenow. 1979. Native faunal relationships in sagebrush ecosystems, p. 50-61. In Proc. of the Sagebrush Ecosystem Symposium. Utah State Univ., Logan, Utah.

Armstrong, R. M., C. R. Blincoe, C. F. Speth and D. R. Hanks. 1981. A comparison of lignin, acid insoluble ash and beryllium as internal ruminant digestion indicators. Proc., Western Section, Am. Soc. Animal Sci., 32:218-219.

Loomis, S. A. 1983. SPUR applications and limitations - Management, p. 111-116. In J. R. Wight (Ed.) SPUR - Simulation of Production and Utilization of Rangelands: A Rangeland Model for Research and Management. U.S. Dept. Agr. Misc. Publ. 1431.

Platts, W. S. and R. L. Nelson. 1983. Population fluctuations and generic differentiation in the Humboldt cutthroat trout of Gance Creek, Nevada. CAL-Neva Wildlife Transactions, 1983:15-19.

Torell, L. A. In press. Economic value of crested wheatgrass: A case study. In Proc. Crested Wheatgrass Symp. Utah State Univ.

Torell, L. A., E. B. Godfrey and D. B. Nielsen. In press. Forage utilization cost differentials in a ranch operation: a case study. J. Range Manage.

Torell, L. A., E. B. Godfrey and R. E. Eckert. In press. Optimal livestock production on the Saval Ranch under season-long grazing and under the approved deferred/rest rotation grazing system. Univ. Nevada. Agric. Exp. Stat. Bull.

1 According to the publications policy adopted by the Executive Committee December 6, 1983, only publications that have undergone the approved review procedures and meet established criteria are listed as project contributions.

<u>OTHER PUBLICATIONS BASED IN PART</u>

<u>OR IN FULL ON SAVAL RANCH DATA</u>

Armentrout, D. J. and M. R. Barrington. 1980. A multiple resource inventory for multiple use land management decisions. CAL-NEVA Wildl. Trans. 1980:92-99.*

Johnson, C. W., M. R. Savabi, and S. A. Loomis. 1984. Rangeland erosion measurements for the USLE. Trans. Amer. Soc. Agric. Eng., 27:1313-1320.

Platts, W. S. and R. L. Nelson. 1985. Streamside and upland vegetation use by cattle. Rangelands, 7:5-7.

Platts, W. S. and R. L. Nelson. 1985. Will the riparian pasture build good streams? Rangelands, 7:7-10.

Platts, W. S., K. A. Gebhardt and W. L. Jackson. In Press. The effects of large storm events on Basin-Range riparian stream habitats. <u>In</u>: Proc. Symp. Riparian Ecosystems and their Management. Univ. Arizona, Tucson.

* Although not approved as a "contribution" of the Saval Project, this publication provides excellent background on the project area and has not previously been listed in annual reports.

PROFESSIONAL ACTIVITIES OF PROJECT PERSONNEL

Gary Back presented the paper, "Sage Grouse Winter Use of a Mixed-Species Seeding," at NV Chapter Meeting, The Wildlife Society, January 13-14, 1984. He also attended the 1984 North American Grouse Group Meeting in Kremmling, CO and gave a progress report on Saval sage grouse research.

Karl Gebhardt gave presentations based in part upon Saval Project work at the following:

BLM Nevada State Watershed Workshop, Las Vegas, February, 1984.

SCS Modeling Workshop, Denver, CO, March, 1984.

BLM Idaho State Watershed Program Workshop, Boise, November, 1984.

SPUR-Rangeland Modeling Seminar, Boise, December, 1984.

National Rangeland Monitoring Committee Meeting, January, 1985.

J. Kent McAdoo gave the following presentations:

Responses of nongame birds to type conversion of sagebrush habitats. Winter Mtg., Nevada Chapter, The Wildlife Society, Elko, Jan. 1984.

Effects of mixed species rangeland seeding on nongame bird communities (Abstract). Soc. Range Manage. 37th Annual Mtg., Rapid City, So. Dakota, Feb. 1984. (With M. A. Ports.)

Feb., 1984. Effects of spraying and plowing of sagebrush range on least chipmunks (Abstract). Soc. Range Manage. 37th Annual Mtg., Rapid City, So. Dakota, Feb., 1984. (With W. S. Longland and M. A. Ports.)

Slide presentation/lecture on nongame birds. Great Basin Lecture Series, Northern Nevada Community College. Oct., 1984.

Slide presentation/lecture on nongame bird research. Bird-watching class, Northern Nevada Community College. Oct., 1984.

Julie Morrow and Dave Brown gave a presentation at the Society for Range Management National meeting, Salt Lake City, February, 1985, entitled, "Factors affecting spatial behavior and activity patterns of cattle on a mountain big sagebrush site."

SITE TOURS AND PRESENTATIONS

April 27-28, 1984 - Class from Utah State University, Logan.

May 4-5, 1984 - Integrated Resource Management class, University of Nevada, Reno.

June 25-28, 1984 - BLM Washington Office staff tour (W. Peterson).

October 9, 1984 - Tour for BLM Boise District personnel.

The following personnel participated in all or some of the above:

G. Back	M. Barrington
J. Barber	K. Gebhardt
P. Lent	J. K. McAdoo
D. W. Stager	R. Torell

CHAPTER 1

CLIMATOLOGICAL RESEARCH

Karl Gebhardt, Carolyn Bohn, Keith Cooley

1984 Objectives

1) To document the climatic characteristics of the study area.

2) To provide reference for extrapolation of resource data to other situes.

3) To provide climatic data input to other study disciplines.

1984 Accomplishments

Continued collection of climatic data at 11 stations and 2 small watersheds.

Restarted vandalized climate station and installed security fence.

Installed monitoring equipment and began participation in the National Atmospheric Deposition Program which is associated with nationwide acid rain research.

Assisted Elko District in installing air quality monitoring equipment at site 2.

Developed data formatting program to make Saval climate data usable by simulation models.

Conducted initial inter-station correlation using 1984 precipitation data.

Conducted initial test runs of ERHYM2 (Ekalaka Rangeland Hydrology and Yield Model) using 5 years of climate data from stations 1, 2, and 5.

The Hydrologic Information Storage and Retrieval System (HISARS) was expanded to include U.S. Weather Service records for Elko County, Nevada.

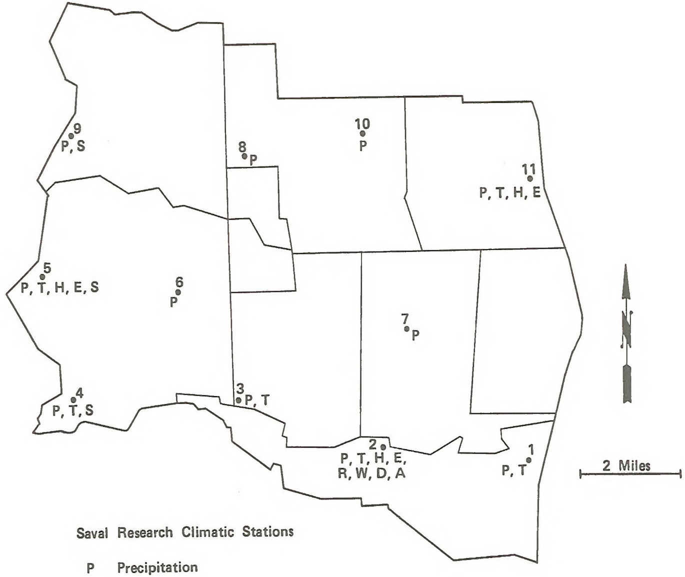
All available wind data collected on the Saval Project was reduced and entered into the ARS/Saval climate data base.

CLIMGEN, a climate generator computer program has been obtained for use on the Saval Project.

Extrapolating Climate Record

Past progress reports have mentioned the efforts in refining precipitation relationships to increase our ability to extrapolate records to uninstrumented areas of the project. The linear equation,

$$Y = 0.0113(X) - 52.8$$



Saval Research Climatic Stations

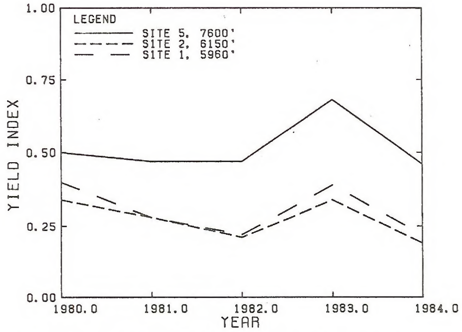
P	Precipitation
T	Temperature
H	Relative Humidity
E	Evaporation
R	Solar Radiation
W	Wind Speed and Direction
D	Dew Point Temperature
S	Snow Course
A	Atmospheric Deposition

Fig. 1.1

Table 1.1. Correlation matrix for selected 1984 precipitation data.

ELEVATION(ft)	SITE #	1	2	3	4	5	7	9	11
5960	1	1.0	.85	.63	.46	.84	.43	.72	.88
6150	2	.73	1.0	.80	.59	.92	.53	.78	.94
6260	3	.62	.79	1.0	.80	.77	.69	.76	.68
6620	4	.36	.49	.75	1.0	.58	.75	.58	.51
7600	5	.82	.91	.70	.39	1.0	.54	.86	.91
6140	7	.52	.60	.70	.68	.52	1.0	.58	.50
7820	9	.86	.80	.67	.37	.88	.49	1.0	.74
5950	11	.82	.93	.67	.40	.91	.54	.81	1.0

Station 9 , independent variable.
Upper diagonal is all days (366x7).
Lower diagonal is all events greater than 0 (74 observations).



GENERIC YIELD INDICES FOR STATIONS 1,2, AND 5

Fig. 1.2

is used to obtain annual precipitation in inches (Y) from elevation in feet (X). Annual precipitation correlation is useful information and when coupled with event correlation can lead to a better understanding of spatial variability. To commence spatial variability analysis in the X-Y plane, 1984 daily precipitation data were correlated at selected stations. The correlation matrix is presented in Table 1.1.

Further analysis will include similar monthly and seasonal correlation. A topographic wind model will be applied to help better define spatial variability. Knowing how to describe precipitation variability on Saval may help to develop a method to extrapolate seasonal precipitation data on similar areas. Such a method would be valuable to field specialists in determining likely precipitation occurrences between gauging sites.

Vegetation Yield Index

Climate data oftentimes is used to normalize vegetation growth observations from year to year. The ERHYM model (Ekalaka Rangeland Hydrology and Yield Model) (Wight, in preparation), was applied on 5 years of Saval climate data at 3 stations of 5960 ft, 6150 ft, and 7600 ft elevation, respectively. The model input requires daily precipitation, temperature, and solar radiation as well as information on vegetation and physical factors for each layer of soil.

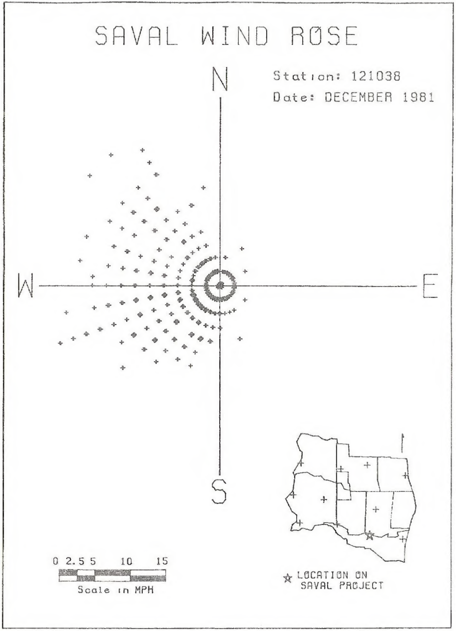
In the simulation runs for the 3 stations, soils data and relative growth curves for the vegetation were held constant while each year's climate data were varied. The results, shown in figure 1.2 can be considered a type of "generic" climate influence on vegetation growth. Such results could be used as a tool for range managers in comparing each year's climatic influence on the vegetation without bias from an individual's perceived observation.

The simulation is presented as one example of what vegetation yield models can provide to help range specialists interpret complexities in annual vegetative growth. Future work on the Saval project will examine similar response using actual site soils data and vegetation for the ERHYM model and more complex, management based models such as the SPUR (Simulation of Production and Utilization of Rangelands) model (USDA, 1983). The SPUR model will allow researchers to apply climatic variability, livestock use, and wildlife consumption in determining changes in vegetation biomass by species. The model also allows for cattle weight determination and economic analysis.

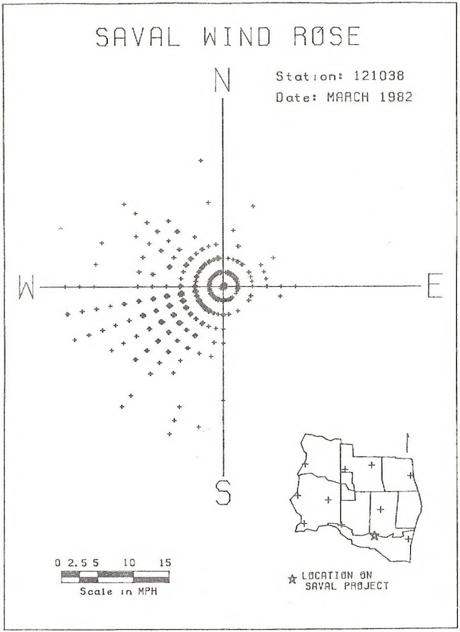
Wind

In 1984 all wind data from Saval station 2 were reduced to digital format and entered into the computer data file. Figures 1.3 and 1.4 are graphical representations of wind velocity, direction and occurrences. Wind is important in evaporation, snow movement, atmospheric processes and precipitation occurrences. The wind data collected to date will be used in a topographical transport modeling effort to help determine spatial variability of precipitation occurrences. The wind data are available in graphical summaries, and in daily tabular summaries which include descriptive jargon, wind velocity, and direction.

Fig. 1.3

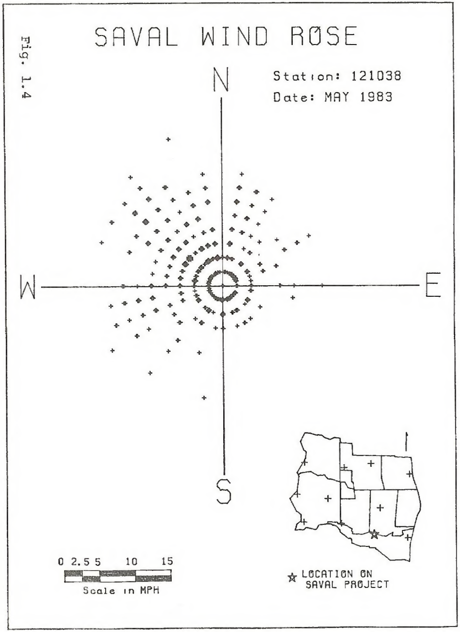


SAVAL WIND RØSE
Station: 121038
Date: DECEMBER 1981
N
S
E
W
0 2.5 5 10 15
Scale in MPH
LØCATIØN ØN
SAVAL PRØJECT

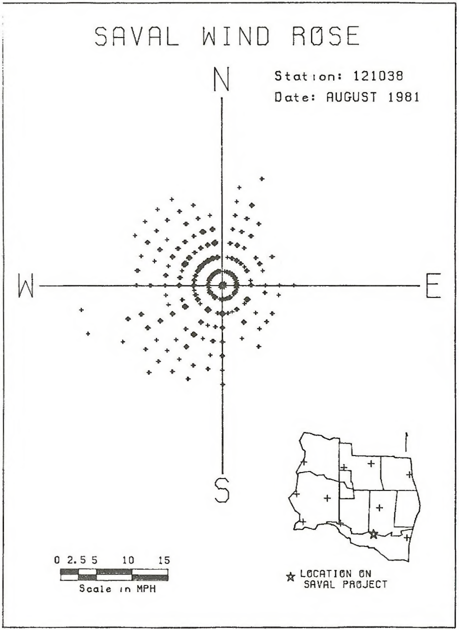


SAVAL WIND RØSE
Station: 121038
Date: MARCH 1982
N
S
E
W
0 2.5 5 10 15
Scale in MPH
LØCATIØN ØN
SAVAL PRØJECT

Fig. 1.4



SAVAL WIND ROSE
Station: 121038
Date: MAY 1983
N
W
E
S
0 2.5 5 10 15
Scale in MPH
LOCATION ON SAVAL PROJECT



SAVAL WIND ROSE
Station: 121038
Date: AUGUST 1981
N
W
E
S
0 2.5 5 10 15
Scale in MPH
LOCATION ON SAVAL PROJECT

Use and Availability of Climate Data

A major purpose of climatic data is to supply information that will be helpful to researchers in analyzing what factors produced observed effects. Any relational use of climatic data in such a manner can be considered a form of modeling. Hydrologic, vegetation, and ecosystem models are tools becoming available for the rangeland community. Such models, usually described with acronyms (i.e., EHRYM, EPIC, CREAMS, HELP, SPUR, SWAM, etc.), should be routinely available in the future. Other in-house models have been developed and are likely to be created in the future.

Climate variables are perhaps the most important driving parameters in most natural system models. Among the important climatic variables are daily values of precipitation, temperature, solar radiation, and wind. To be of use to modeling, these data must be easily available in a convenient-to-use format.

All of the above climate data collected by the Saval project are processed through the Agricultural Research Services. Northwest Watershed Research Center computer facilities located in Boise, Idaho. The data have been reduced to summary and detailed format and are easily transferred to most computer facilities via tape or modem. Selected precipitation records have been transferred to the BLM's Honeywell DPS8 in Denver. Eventually these will also be available as part of the Nevada Watershed Study Files. Hard copy is also available.

When requesting data, the following questions should be answered:

> What parameters are requested? (Default is maximum and minimum temperature, daily precipitation.)
>
> How do you want the data formatted? (Default will be in standard SPUR model format (year, Julian day, precipitation, maximum temperature, minimum temperature, solar radiation, wind run, and Fortran formats 2I4 and 5F10.4).
>
> What period of record do you want? (Default is 1980 to present for Saval Stations, specify for other records (see following sections on CLIMGEN and HISARS)).
>
> What stations? (Default is station 2.)

Acknowledgements

Many thanks to Apryl Wilson for the long hours she spent reducing the wind data and to David Potter for his beautiful work on the wind graphics.

Literature Cited

Molnau, Myron. 1983. Climate and Hydrology Data for Idaho. University of Idaho, Moscow, Idaho, 116p.

Richardson, C. W. and D. A. Wright, 1984. WGEN:A model for generating daily weather variables. U.S. Department of Agriculture, Agricultural Research Service, ARS-8, 83p.

Skiles, J. W., in preparation. CLIMGEN User's Guide. U.S. Department of Agriculture, Agricultural Research Service, Boise, Idaho.

USDA, 1983. spur -- Simulation of Production and Utilization of Rangelands: A rangeland model for management and research. USDA, Misc. Pub. 1431, 120p.

Wight, J. R., in preparation. ERHYM2 User's Guide. USDA Agricultural Research Service, Boise, Idaho.

CHAPTER 2

HYDROLOGY

Karl Gebhardt, Carolyn Bohn, Keith Cooley

1984 Objectives

1) Reduce backlog of unprocessed stage charts.

2) Describe quality of runoff charts.

3) Define specific objectives of hydrology research.

4) Analyze channel transect data on Gance Creek and Mahala Creek.

5) Instrument small watershed with erosion plots and soil moisture/temperature recording equipment.

6) Obtain vandal-resistant shelters for continuous sediment samplers.

7) Examine all existing data for usable information.

1984 Accomplishments

All unprocessed data charts have been reviewed. Qualitative record descriptions have been made.

Mahala Creek channel cross-sections data have been entered into the computer for 1981 and 1982, and selected stations for 1983.

Specific objectives of the hydrology research have been agreed upon by the authors. A small watershed committee has been established, however, no meetings have been held to date.

Four small erosion plots were constructed and instrumented on the gravel pit small watershed.

Two vandal-resistant shelters were designed and constructed.

About 80% of the old data base contained in various file drawers, map tubes, and envelopes has been reviewed. Cataloging is planned for 1985.

Serviced flumes, recorders, gages and surveyed-in Highway stations at Gance Creek and Mahala Creek.

Hydrology Objectives

The following hydrology conclusions, recommendations and objectives were agreed to by the authors.

Sheep Creek -

There is no known continuous sediment data for Sheep Creek above or below the seeding. The changes that have taken place have been documented and a final report will be written. The effect of high flows probably has made detection of sediment yield changes due to the seeding indeterminate. 1984 will be the last year for sediment/discharge data collection on Sheep Creek related to the seeding. All data that would have shown short-term comparative changes are assumed to have been taken.

Gance Creek -

Continue continuous discharge measurements at existing stations. Direct research more towards determining geomorphological effects of grazing management and other land use. Increase cooperative efforts within the USFS riparian study area by conducting continuous sediment sampling, surveying of bottom profile, quantification of bedload sediment, and study on the effects of ice on channel form.

Jim Creek -

Since data collection is minor and the drainage is significant to the Mahala Creek hydrology, data collection will continue at current levels.

Mahala Creek -

Consider dropping sampling location 22. Increase the effort on channel data analysis and use past stream stability inventories to develop possible causes to channel modification. Continue operation of the discharge gages and suspended sediment collection effort.

Small watersheds -

Continue operation of the four small watersheds. Consider upgrading USFS site 1 and 2 by rebuilding the sheds, installing heat, and building a sediment trap. Consider small erosion plots similar to the Gravel Pit plots on one or more of the small watersheds. Instrument the small watersheds with soil moisture/temperature hardware. Begin quantification of vegetation including production for tuning of rangeland simulation models. Develop small watershed plan for each watershed and get the plan approved through the Small Watershed Committee.

Flooding

1983 and 1984 produced the highest flows on record for the Savel project at Gance and Mahala creeks. Peakflow records at the Upper Gance and Upper Mahala gaging stations were 114 and 57 cubic ft/sec respectively in 1983. 1984 peakflows were 154 and 68 cubic ft/sec respectively, both on May 12 (USGS, personal communication). Streamflows at both highway gages exceed the measurement charts in 1983. Peakflows were buffered by backwater because of the highway culverts. An accurate peakflow may be impossible to obtain even with surface water profile modeling.

Gance Creek and Mahala Creek Channel Morphology

As mentioned above, 1983 and 1984 were significantly high discharge years. In recent years the effects of management on riparian systems has been a range management issue. In addition, the effects of flooding and land use on channel morphology and erosion has been an equal concern. The purpose of the Gance Creek and Mahala Creek Channel studies is to quantify channel morphological characteristics, monitor trends, identify possible change agents, and suggest methods to avoid serious problems on similar riparian systems.

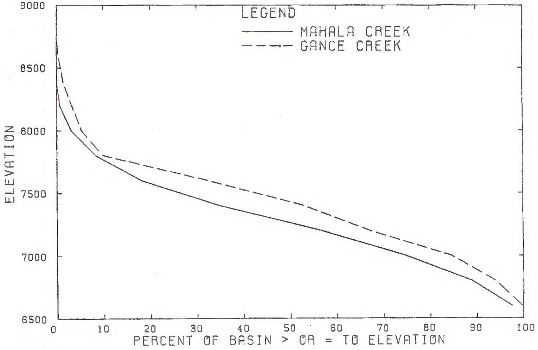
Gance and Mahala creeks offer interesting comparisons. Fig. 2.1 shows the relative small percentage of land area within the higher elevations. However, this smaller, higher elevation land is usually the largest water yielding zone in the entire drainage. Fig. 2.2 to 2.10 show cross sections of Gance Creek and Mahala Creek. The location of these transect areas are described in the hydrology section of the 1981 progress reports and the fisheries section of the 1983 progress reports. It should be noted that Mahala Creek shows significant down-cutting when compared to Gance Creek. Fig. 2.11 represents the minimum channel elevation change of Mahala Creek. Channel down-cutting on Gance Creek was not apparent in the cross sections measured.

Mahala Creek showed extreme changes in channel elevation at areas of previous head-cutting. Lateral changes in Gance Creek were apparent at some cross sections, but were notably lacking on Mahala Creek. It is apparent from the cross sections and observations at the meadow below the Foothill Road (see photos, Fig. 2.12 and 2.13), that Mahala Creek riparian system has completely changed. The meadow should lose soil moisture over the next few years and become a completely altered site.

Aerial photos taken in the summer of 1984 will be analyzed in 1985 to determine the areal extent of the erosion and deposition areas. Past photos, surveys, and transects will be examined to the nature of the change agents (stream blockages, grazing, roads, etc.). The upland effects of grazing on the discharge hydrology requires investigation as well. Hydrologic response models are being applied to both Gance and Mahala Creek. The results should provide an interesting case study into the combined effects of naturally high events and land use practices.

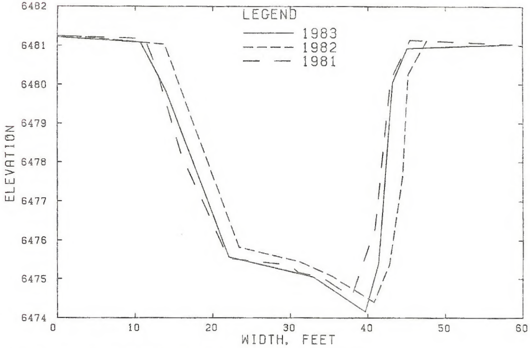
Erosion Plots

In cooperation with the Denver Service Center, four 35 ft by 10 ft erosion plots were constructed at the Gravel Pit small watershed in the summer of 1984. These plots are part of an effort to develop an inexpensive erosion/runoff monitoring tool. The sites, located in the soil mapping unit 102 (Stampede Series), are dominated with mountain big sage, antelope bitterbrush, alkali sage, sandberg's bluegrass, and cheatgrass. The sites will be monitored for soil erosion and runoff without grazing during a sufficient number of events to quantify variability. Later, the plots will be paired into grazing/no grazing or perhaps system/no system grazing.



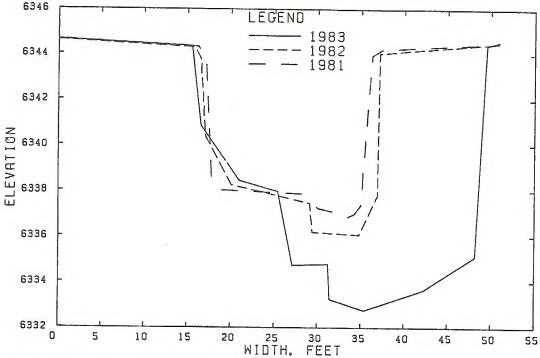
AREA-ELEVATION RELATIONSHIP, GANCE AND MAHALA CREEK

Fig. 2.1



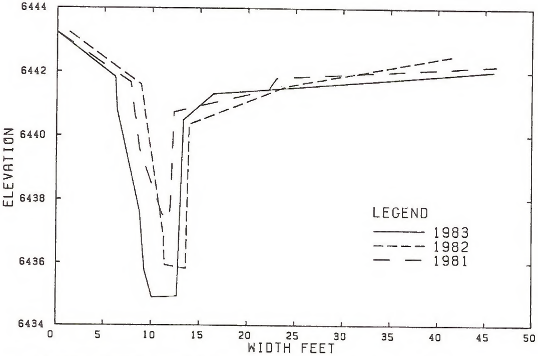
MAHALA CREEK CROSS SECTION NO. 1, NEAR USGS GAGE

Fig. 2.2



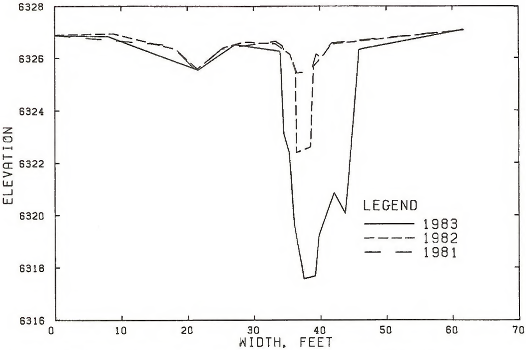
MAHALA CREEK CROSS SECTION NO. 15, ABOVE SCS DIVERSION

Fig. 2.3



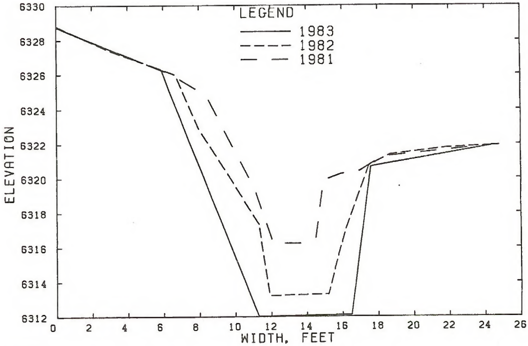
MAHALA CREEK CROSS SECTION NO. 5, 1/4 MILE BELOW USGS GAGE

Fig. 2.4



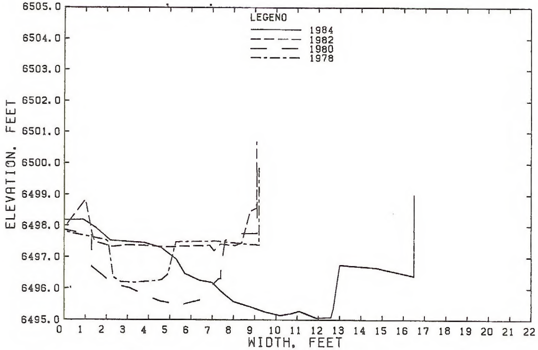
MAHALA CREEK CROSS SECTION NO. 19, JUST ABOVE SCS DIVERSION

Fig. 2.5



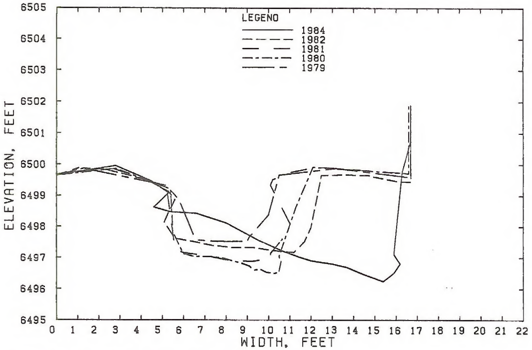
MAHALA CREEK CROSS SECTION NO. 23, BELOW SCS DIVERSION

Fig. 2.6



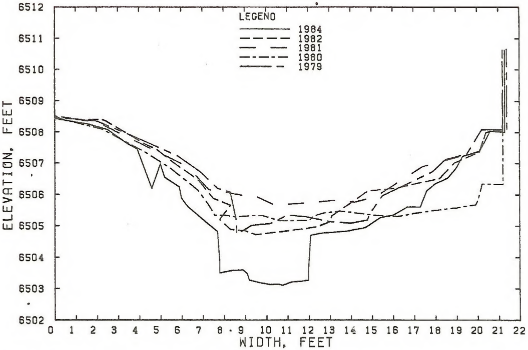
GANCE CREEK CROSS SECTION 043, 1978-84

Fig. 2.7



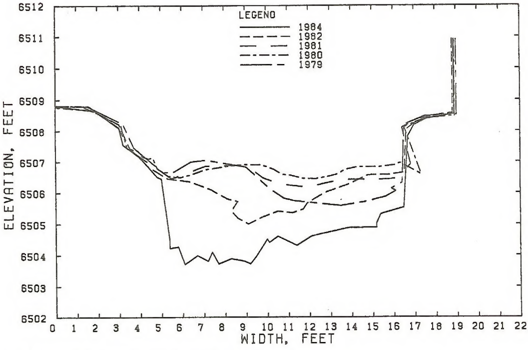
GANCE CREEK CROSS SECTION 048, 1979-1984

Fig. 2.8



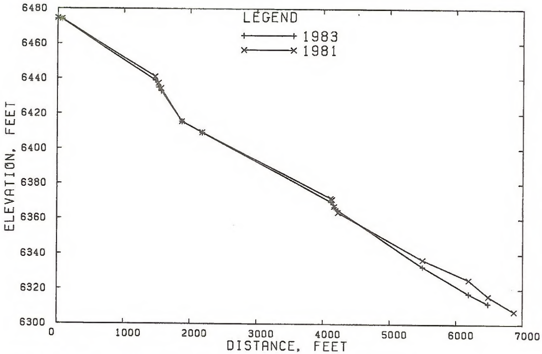
GANCE CREEK CROSS SECTION 088, 1979-1984

Fig. 2.9



GANCE CREEK CROSS SECTION 089, 1979-1984

Fig. 2.10



MAHALA CREEK LONGITUDINAL PROFILE AT SELECTED TRANSECTS

Fig. 2.11

Fig. 2.12. Mahala Creek. Meadow below Foothills Rd. crossing. 1981.

Fig. 2.13. Mahala Creek, 1984. Same area showing down-cutting.

Soil moisture and temperature are being measured at two depths, near surface and about 25 cm. using erasable-programmable recording hardware. In addition, vegetation production will be collected along with the current hydrological and climatological information being collected. It is anticipated that each small watershed will eventually be equipped with this low-cost monitoring tool. Much of the information collected will be used to evaluate the modifications to the Universal Soil Loss Equation (Renard et al.) and the Erosion and Productivity Impact Calculator (Williams et al. 1984).

Annual Maintenance

Part of the recent ARS responsibility for the Saval hydrology project is to examine the equipment in-place and offer suggestions for repair, replacement, or removal. On September of 1984 the flumes on Gravel Pit and Mahala H small watersheds were inspected by ARS scientists. They installed a larger orifice on the site raingauges, checked calibration, zeroed the flume and channeled around the gagehouse to prevent water from getting inside. They recommended that larger raingauge shields be put on the raingauges to improve data collection accuracy.

Acknowledgement

Thanks to Apryl Wilson for her many dedicated hours on chart reduction. The backlog of data could not have been decreased without her help.

Literature Cited

Williams, J. R., P. T. Dyke, and C. A. Jones. 1982. EPIC -- a model for assessing the effects of erosion on soil productivity. Proc. of Third Intern. Conf. on State-of-the-Art in Ecological Modelling, Colorado State University, May 24-28.

CHAPTER 3

VEGETATION RESEARCH

D. WAIVE STAGER, RICHARD E. ECKERT, JR., AND FAY L. EMMERICH

VEGETATION MONITORING

1984 Objectives:

1. Establish additional transects and reread old transects to determine species frequency and ground cover characteristics on various upland and riparian range sites.
2. Continue sampling for density and cover of tree and shrub species on new and previously established transects.

1984 Accomplishments:

Methods. Sampling for frequency of occurrence in 1984 was done using the nested-plot method (Winward and Martinez 1983) rather than the single-plot method used in previous years. The nested-plot approach allows the evaluation of data for each species from more than one quadrat size since frequency values are computer-generated for three quadrat sizes. This becomes valuable if there is a large change in species frequency over time and data must be interpreted from a quadrat size different from that previously used.

Our sampling design is 10 transects of 20 quadrats each. Each quadrat consists of a "nest" of three quadrat sizes. On upland sites these sizes are: 5x5 in., 10x10 in., and 20x20 in. Quadrat sizes used on riparian sites are: 2.5x2.5 in., 5x5 in., and 10x10 in. Quadrats are located contiguously along each transect line. These lines have been permanently marked at both ends so the same line of quadrats is sampled in each year.

Living and non-living ground cover was determined from 600 points per site. Canopy cover and density of shrub species were sampled by methods described in the 1981 Saval Progress Report. One-way analysis of variance was used to test for significant differences ($P \leq 0.05$) in total shrub canopy cover between years on plots read in 1983 and in 1984.

In 1984, eight additional frequency and ground cover transects were established: two on untreated areas in the Lower Sheep Creek Seeding, two on untreated areas in the East Darling Seeding, one in the Mahala Control Pasture, one in the Upper Mahala Creek Pasture and two in the South Forest Service Pasture. Thirty-one transects established in previous years were reread in the Lower Sheep Creek, East Darling, Lower Mahala, Middle Mahala, Mahala Control and South Forest Service Pastures (Fig. 3.1). Statistical procedures for analysis of frequency data are being developed.

Figure 3.1. R. Rusin, B. Rust, P. Slaton, and M. Summers conducting vegetation research on the Loamy 8-10". Range Site in Lower Mahala Pasture. Photo by D. W. Stager.

In July 1982, Eckert and Dailey (1983 Saval Progress Report) evaluated the success of the Lower Sheep Creek Seeding. They sampled frequency of occurrence (% stocked) for each species seeded on 40, 1-ft^2 subplots at each site. From these data, seeding success, based on the frequency of crested wheatgrass, was assigned to each site according to the rating developed by Hyder and Sneva (1954):

Success Rating	Percentage Stocked
Excellent	50% or more
Good	40-49%
Fair	25-39%
Poor	10-24%
Failure	9% or less

In 1983, we established six transects in the Lower Sheep Creek Seeding in areas evaluated in 1982 by Eckert and Dailey. These transects were read in 1983 and again in 1984, the third growing season. The 10x10 in. quadrat we used for frequency sampling in 1984 is slightly smaller than the 1-ft^2 quadrat used to evaluate the seeding in 1982 but is close enough in size to be used for comparison purposes.

Results. Table 3.1 presents the seeding success ratings for six transects from the 1982, 1983 and 1984 evaluations of the Lower Sheep Creek Seeding. These ratings indicate the seeding is improving.

Table 3.2 presents 1983 and 1984 frequency of occurrence values for some of the seeded and native species on six transects in the Lower Sheep Creek Seeding. The procedure for statistical analyses of frequency data is still being developed so only general trends can be presented. The two seeded wheatgrasses appear to be increasing, probably due to new plants from seed produced in 1982 and 1983. The seeded forb, small burnet, shows no change in frequency on any of the six plots.

The frequency of the two native grass species on the seeding may have changed significantly (Table 3.2). Sandberg bluegrass generally seems to be decreasing in frequency while bottlebrush squirreltail appears to be increasing. The decrease in bluegrass may be an adverse reaction to weather conditions the past 2 years and/or a result of increased competition from squirreltail and the two seeded wheatgrasses. The increase in squirreltail may be due to favorable climatic conditions over the past 2 years and/or a response to a reduction in competition due to shrub removal prior to seeding.

Changes in the frequencies of the three native shrubs are small and probably are not significant (Table 3.3). However, total shrub canopy cover has increased significantly ($P \leq 0.05$) between 1983 and 1984 on three of the six plots. This increase in total shrub canopy cover without an accompanying increase in shrub frequency probably means that the number of plants is not increasing but the canopy size of existing shrubs was larger in 1984.

Plots in the East Darling Pasture read in 1982 and again in 1984 showed changes in frequency of a few species that may be significant. Crested wheatgrass may have declined significantly on one of five plots. Sandberg bluegrass appeared to decrease on most plots and squirreltail did not seem to increase as it did in the Lower Sheep Creek Seeding. Total shrub canopy cover increased significantly ($P \leq 0.05$) on only one of the five plots between 1982 and 1984. Frequencies of shrub species increased on some plots, declined on some, and remained stable on others. Until statistical procedures are developed, we cannot determine the significance of these frequency and cover changes.

Plots in the Middle Mahala Pasture were read in 1981 and again in 1984. As an example of changes in native vegetation, Table 3.4 presents the frequency values (from 1981 and 1984) for a Loamy 10-12" Range Site plot. There has been very little change in shrub and grass frequencies in 3 years. However, there appears to be quite a difference in forb frequency. More species of forbs were recorded in 1984 than in 1981. Also, frequencies of rockcress, crag aster, spring parsley, and longleaf phlox were much higher in 1984 than in 1981.

Table 3.1. Indicated success ratings based on frequency of occurrence of crested wheatgrass in a 10x10 in. quadrat on monitoring transects in the Lower Sheep Creek Seeding (seeded fall 1981).

Plot	1982	1983	1984
	Success Rating		
83-01	Good	Excellent(57%)*	Excellent (64%)
83-02	Excellent	Good (41%)	Excellent (61%)
83-03	Fair	Good (47%)	Excellent (59%)
83-04	Poor	**	Good (42%)
83-05	Poor	**	Poor (24%)
83-06	Fair	**	Fair (30%)

*Percent stocked or frequency of occurrence in 10x10 in. quadrat.
**Data not available in 1983 for 10x10 in. quadrat.

Table 3.2. Frequency (%) on 10x10 in. or 20x20 in. plot size in 1983 and 1984 of some seeded and native species on six monitoring transects in the Lower Sheep Creek Seeding (seeded fall 1981).

Plot:	83-01		83-02		83-03		83-04		83-05		83-06	
Year:	1983	1984	1983	1984	1983	1984	1983	1984	1983	1984	1983	1984
	% Frequency											
Seeded Species:												
Crested wheatgrass	57[1]	64[1]	41[1]	61[1]	47[1]	59[1]	59	72	44	55	45	60
Pubescent wheatgrass	53	55	60	77	44	56	20	36	24	33	27	32
Small burnet	2	2	5	T[2]	0	4	1	2	0	0	5	2
Native Species:												
Wyoming big sagebrush	2	4	6	5	12	9	14	18	8	6	4	3
Alkali sagebrush	18	13	0	0	0	0	0	0	0	0	18	15
Low rabbitbrush	4	3	11	15	22	23	4	6	1	2	45	42
Sandberg bluegrass	22	18	28	14	5	3	7	2	10	8	49	35
Bottlebrush squirreltail	65	70	4	58	42	88	32	57	5	36	26	70

[1] 10x10 in. quadrat used, rather than the 20x20 in. quadrat, due to high frequency values.
[2] T $\leq$ .5%.

Table 3.3. Shrub canopy cover (%) in 1983 and 1984 on six monitoring transects in the Lower Sheep Creek Pasture (seeded fall 1981).

Plot:	83-01		83-02		83-03		83-04		83-05		83-06	
Year:	1983	1984	1983	1984	1983	1984	1983	1984	1983	1984	1983	1984
	% Canopy Cover											
Species												
Wyoming big sagebrush	0	T[1]	1	3	4	6	3	9	2	2	T	1
Alkali sagebrush	2	3	0	0	0	0	0	0	0	1	6	3
Low sagebrush	T	T	2	6	3	7	T	2	T	1	8	10
Total[2]	3	4	3	9*[3]	8	12*	3	11*	2	3	14	13

[1]T $\leq$ 0.5%.
[2]Due to rounding "Total" values may differ from sum of the columns.
[3]Significantly different ($P \leq 0.05$) between 1983 and 1984.

Table 3.4. Frequency (%) of shrubs, grasses, and forbs in 1981 and 1984 on a plot representing the Loamy 10-12" range site in the Middle Mahala Pasture.

	1981	1984		1981	1984
	Frequency (%)			Frequency	(%)
Shrubs			Forbs		
Wyoming big sagebrush	43	42	Pale agoseris	0	10
Low rabbitbrush	5	7	Wild onion	0	44
			Low pussytoes	T	T
			Rockcress	1	15
Grasses			Crag aster	46	64
Cheatgrass	0	25	Locoweed	0	2
Sandberg bluegrass	45[1]	42[1]	Troutcreek milkvetch	0	46
Bottlebrush squirreltail	43[1]	46[1]	Douglas chaenactis	0	2
Thurber needlegrass	0	T[2]	Thistle	0	2
			Spring parsley	16	38
			Cushion eriogonum	2	2
			Nevada lomatium	0	13
			Lupine	0	58
			Oblongleaf bluebells	0	14
			Pricklypear	0	T
			Penstemon	2	2
			Hoods phlox	4	4
			Longleaf phlox	25	54
			Douglas blue-eyed grass	0	3

[1] 10x10 in. quadrat used, rather than the standard 20x20 in. quadrat, due to high frequency.
[2] T $\leq$ .5%.

These differences are probably climate related. Many forbs may not have grown in 1981 because it was a drought year while in 1984 forbs grew abundantly due to high moisture conditions. Many of these forbs dry up and blow away when mature and are not visible when an area is sampled. Sampling in 1981 was about 2 weeks later than in 1984 so many forbs may have grown and matured early that year and were not present when the sample was taken.

Early in the 1984 field season, we noticed large numbers of grass and shrub seedlings and decided to record frequency of these seedlings separately from mature plants. Table 3.5 presents seedling frequencies on selected plots representing various range sites sampled in 1984. We feel that the last 2 years with high precipitation were very favorable for seedling emergence and that frequency values are higher than for normal years. Eckert (1983 Saval Progress Report) reported high seed yields from increaser species and low seed yields from decreaser species. Seedling frequencies showed the same pattern. Seedlings of increaser species such as the two sagebrushes, Sandberg bluegrass, and squirreltail had higher frequencies on most range sites than did seedlings of decreaser species such as antelope bitterbrush, Thurber needlegrass, and Webber ricegrass. In years like 1983 and 1984 when moisture is abundant, there may be the opportunity for new plants to become established in the community. However, it is most likely that increaser species will establish rather than decreaser species simply because there are so many more seedlings of the former than of the latter.

Table 3.5. Frequency (%) of seedlings of common shrub and grass species on selected examples of range sites in the Lower Sheep Creek (LSC), East Darling Seeding (EDS), Middle Mahala (MM) and Mahala Control (MC) Pastures in 1984.

Range Site and Pasture		Low sagebrush	Wyoming big sagebrush	Antelope bitterbrush	Crested wheatgrass	Bluebunch wheatgrass	Sandberg bluegrass	Bottlebrush squirreltail	Thurber needlegrass	Webber ricegrass
					Frequency (%)					
Seeding	(LSC)	-[1]	3	-	17[3]	-	T[4]	11	-	0
Seeding	(EDS)	T	T	-	41	-	0	1	-	-
Loamy 8-10"	(MM)	0[2]	6	-	-	-	68	78	T	0
Loamy 10-12"	(MC)	-	21	2	-	5	89	72	3	0
Claypan 10-12"	(MM)	12	-	-	-	-	69	65	3	7
Claypan 12-16"	(MC)	36	0	2	-	-	59	81	6	0

[1] Neither mature plants or seedlings of a species occur on plot.
[2] Mature plants occur on plot but no seedlings were found.
[3] 10x10 in. quadrat used, rather than the standard 20x20 in. quadrat, due to high frequency.
[4] $T \leq .5\%$.

UTILIZATION

1984 Objective:
Estimate species utilization on major range sites at the end of respective grazing periods and at end of the growing season.

1984 Accomplishments:

Methods. The "Key Forage Plant Method" was used to estimate forage utilization at the end of the grazing and growing seasons on frequency transects and on other sample areas of different range sites in various pastures. These estimates were used to identify cattle preferences among range sites, changes in species and range site preferences over the grazing season, differences in species and range site preferences among years, and impact of grazing on plants as indicated by residual use at the end of the growing season.

Results. The Lower Sheep Creek (LSC) and West Darling (WD) Pastures were grazed by the main Saval cow herd from April 23 to May 15 and from May 16 to June 4, respectively. Use was in the heavy (61-80%) class on seeded areas in both pastures at the end of the grazing period (Table 3.6). However, the actual utilization attained was 60-65% (low end of the heavy class). This is proper use for crested wheatgrass seedings, since utilization tends to be even throughout a pasture and development of wolfplants is reduced. Under the Saval Management Plan, grazing of seeded pastures at this level occurs early enough in the season so that in many years seeded grasses on both the early- and deferred-use pastures will regrow and set seed. Unseeded range sites in both pastures received slight (0-20%) to light (21-40%) use except the Wet Meadow range Site in the WD Pasture which received moderate (41-60%) use. Crested wheatgrass in early leaf was the primary species grazed in both pastures. Wet meadow species (Nevada bluegrass, sedges, and rushes) received moderate to heavy use (Table 3.7). Regrowth and seed production by crested wheatgrass and wet meadow species was excellent due to another year of abundant available soil moisture. Due to this regrowth, utilization at the end of the growing season was slight.

The Upper Mahala Creek (UMC) Pasture was grazed from June 5 to June 22. Use was moderate on the Loamy 10-12" and Loamy Slope 10-16" Range Sites (Table 3.6). Use on all other sites was slight to light. From June 23 to July 9, cattle grazed the Upper Sheep Creek (USC) Pasture. Use was moderate on the Loamy Slope 10-16" Range Site and slight to light on all other range sites. Sandberg bluegrass, a common upland species in both pastures, received moderate use in the UMC Pasture (Table 3.7). Sandberg bluegrass is the earliest developing grass on the Saval Allotment and over the past 4 years, was the most utilized upland grass while in early leaf to prebloom phenology stages. In the USC Pasture it received very little use when in bloom to seedripe phenology stages. Use on all other species was slight to light in both pastures.

Table 3.6. Vegetation utilization by cattle on range sites on the Saval Allotment pastures for the 1984 grazing season

	Main Herd						Yearling Herd	
Range Site	Lower Sheep [1] (4-23 to 5-15)	West Darling (5-16 to 6-4)	Upper Mahala (6-5 to 6-22)	Upper Sheep (6-23 to 7-9)	National Forest (7-10 to 8-31)	National Forest (9-1 to 9-30+)	Seeding Control (6-18 to 7-18)	Native Control (7-19 to 8-13)
Crested wheat seeding	4-[2]	4-	--	--	--	--	4-	--
Loamy 8-10"	1	2-	1-	1-	--	--	--	3
Claypan 10-12"	1-	1	2	1-	--	--	--	3-
Loamy 10-12"	--[3]	--	3+	2	--	--	--	3+
Loamy Slope 10-16"	--	--	3	3-	2+	2+	--	--
Loamy Bottom 8-14"	1+	--	--	1-	--	--	--	--
Claypan 12-16"	--	--	--	1-	1-	1-	--	3
Wet Meadow 10-16"	--	3+	1	1-	4	4	--	4+
Dry Meadow 10-16"	--	--	1	2	2+	2	--	5-
South Slope 12-14"	--	--	--	--	2	1	--	--
South Slope 14-18"	--	--	--	--	2-	2	--	--
Loamy Slope 16+"	--	--	--	--	2	1-	--	--
Steep North Slope 16+"	--	--	--	--	0	0	--	--
Aspen woodland	--	--	--	--	2	3-	--	--
Mt. Ridge 16+"	--	--	--	--	0	0	--	--

[1] Grazing period

[2] Utilization classes:
0 = No use = 0%
1 = Slight = 1-20%
2 = Light = 21-40%
3 = Moderate = 41-60%
4 = Heavy = 61-80%
5 = Severe = 81-100%
+ or - indicates use was at the high or low end of a class

[3] Range site not present

Table 3.7. Utilization by cattle of common species on the Saval Allotment Pastures for the 1984 grazing season

	Main Herd						Yearling Herd	
Species	Lower Sheep (4-23 to 5-15)[1]	West Darling (5-16 to 6-4)	Upper Mahala (6-5 to 6-22)	Upper Sheep (6-23 to 7-9)	North National Forest (7-10 to 8-31)	South National Forest (9-1 to 9-30)	Seeding Control (6-18 to 7-18)	Native Control (7-19 to 8-13)
Crested wheatgrass	4[2]	4-	--	--	--	--	4	--
Sandberg bluegrass	2	2-	3+	1-	0	1	1-	0
Bottlebrush squirreltail	1-	1-	1-	1-	0	0	--	3
Thurber needlegrass	--[3]	2-	1	1+	--	--	--	3+
Webber ricegrass	1	--	1-	1-	--	--	--	4
Great Basin wildrye	0	--	1	2	2-	1+	--	3+
Bluebunch wheatgrass	--	--	2-	1+	2-	1	--	2+
Spike fescue	--	--	--	2-	2+	1	--	--
Needlegrass sp.	--	--	2+	1-	1+	1	--	--
Mountain brome	--	--	--	--	0	1	--	--
Nevada and Kentucky bluegrass[4]	2-	4	2-	1+	4-	4-	--	4-
Sedge	0	4+	1	1-	4-	3+	--	4+
Rush	--	3	0	0	3+	3	--	5-
Antelope bitterbrush	--	--	0	0	1+	1+	--	4-

[1] Grazing period

[2] See Table 3.6 for utilization classes

[3] Species not present

[4] Nevada bluegrass on BLM pastures
Mainly Kentucky bluegrass on NF pastures

During June and early July, most forage species in the UMC and USC Pastures matured from early leaf or prebloom phenology stages to peak bloom or seedripe stages (Table 3.8). Grazing grasses in early leaf to bloom phenology stages is beneficial to cattle, but detrimental to plants. When phenology approaches bloom stage, plants are productive, and herbage is ideally balanced in minerals, vitamins, proteins, carbohydrates, roughage, and moisture for livestock gain. However, grazing can be harmful to plants when carbohydrate reserves are at a minimum and when regrowth after grazing is unlikely. This occurs about the time flower stalks are showing. The Saval Management Plan was designed to minimize any harmful effects of use during this time through a stocking rate to achieve moderate utilization during the grazing period and by providing for complete rest in the year following late spring grazing. Light use and some regrowth after grazing on both UMC and USC Pastures resulted in slight use and no harmful effects on most species at the end of the growing season.

The Seeding Control (SC) and Native Control (NC) Pastures were grazed by yearlings from mid-June to mid-July and mid-July to mid-August, respectively. Crested wheatgrass in the prebloom and bloom phenology stages was the main species grazed in the SC Pasture. Use in this pasture was heavy at the end of the grazing period (Table 3.6) as in the two other seeded pastures grazed earlier in the year. However, since grazing in this pasture ended late in the season, little regrowth occurred and use measured at the end of the growing season was moderate.

In the NC Pasture, use on the Wet Meadow and Dry Meadow Range Sites was heavy and severe (81-100%), respectively, and moderate on all other range sites (Table 3.6). Meadow species in bloom to seedripe phenology stages (Table 3.8) received heavy to severe use (Table 3.7). Webber ricegrass and antelope bitterbrush in seedripe to seed-dissemination phenology stages also received heavy use. Sandberg bluegrass was mature and dry during this period and was not used. All other species in this pasture received moderate use. No regrowth occurred after yearlings were removed so use levels at the end of the growing season were the same as at the end of the grazing period.

About July 10, the main cow herd was moved from USC Pasture to the North National Forest (NNF) Pasture. In late August and early September, the herd was moved into the South National Forest (SNF) Pasture, where they grazed until early October. Use on the Wet Meadow Range Site was heavy in both pastures by the end of their respective grazing periods (Table 3.6). Use was slight to light on all other range sites except for moderate use on the Aspen Woodland Range Site in the SNF Pasture. These rather low levels of use on most range sites are probably due to a reduction in herd size and high forage production in 1984.

In the previous 4 years, utilization on range sites in the early summer-use pasture has generally been higher than on the same range sites in the late summer-use pasture. This pattern was followed on some range sites in 1984 but not on the majority of sites (Table 3.6). Utilization levels were generally lower than last year on the early use pasture and equal or slightly higher on the late use pasture.

Table 3.8. Relative preference (based on utilization estimates) of cattle for forage species in various phenology stages on BLM native range.

Species		Phenology (Early June to mid-June)	Species		Phenology (Mid-June to Early July)	Species		Phenology (Mid-July to mid-August)
Sandberg bluegrass	(1)*	Start bloom to peak bloom	Great Basin wildrye	(1)	Prebloom to bloom	Rushes	(1)	Seedripe
Nevada bluegrass	(2)	Prebloom to start bloom	Spike fescue	(1)	Early leaf to prebloom	Sedges	(2)	Seedripe
Bluebunch wheatgrass	(2)	Early leaf to prebloom	Idaho fescue	(1)	Prebloom to bloom	Nevada bluegrass	(2)	Peak bloom to seedripe
Sedges	(3)	Bloom	Nevada bluegrass	(2)	Start bloom to peak bloom	Webber ricegrass	(2)	Seedripe to green,cast
Great Basin wildrye	(3)	Early leaf to prebloom	Bluebunch wheatgrass	(2)	Start bloom to peak bloom	Antelope bitterbrush	(2)	Seedripe to green,cast
Thurber needlegrass	(3)	Prebloom	Thurber needlegrass	(2)	Bloom to seedripe	Thurber needlegrass	(3)	Seedripe to green,cast
Idaho fescue	(4)	Prebloom	Sedges	(3)	Bloom to seedripe	Great Basin wildrye	(3)	Bloom to seedripe
Bottlebrush squirreltail	(4)	Prebloom to start bloom	Sandberg bluegrass	(3)	Peak bloom to seedripe	Idaho fescue	(3)	Bloom to seedripe
Webber ricegrass	(4)	Prebloom to start bloom	Bottlebrush squirreltail	(3)	Start bloom to peak bloom	Bottlebrush squirreltail	(3)	Seedripe to green,cast
			Webber ricegrass	(3)	Bloom to seedripe	Bluebunch wheatgrass	(4)	Bloom to seedripe
						Sandberg bluegrass	(5)	Seedripe to dry,cast

* Preference Level

(1) = 1st

(2) = 2nd

(3) = 3rd

(4) = 4th

(5) = 5th

The most heavily grazed species in both pastures (Table 3.7) were the wet meadow species: meadow bluegrasses, rushes, and sedges. Other species used on these pastures were spike fescue, Great Basin wildrye, bluebunch wheatgrass, needlegrass, and antelope bitterbrush. In the late-use pasture, slight use was made of fall greenup on Sandberg bluegrass.

Most grasses in the NNF were in prebloom or bloom phenology stages (Table 3.9) when cattle were turned in during July and either reached seed-ripe or cast seed by the end of the early-summer grazing period. As on BLM pastures, the management plan for National Forest (NF) pastures also attempts to mitigate any negative effects of grazing when carbohydrate levels in plants are low. Negative effects are reduced because plants grazed during a critical growth stage in 1 year are deferred until seed ripe the following year. This practice is probably more effective on upland species that receive moderate use than on wet meadow species that receive heavy to severe use in both the early- and late-use pastures.

Utilization estimated at the end of a grazing period on both NF pastures would be the same as utilization determined at the end of the growing season because the growing season terminated before use estimates were made. Cattle probably maintained a high level of nutrition thru early August on the NNF Pasture. However, the level of nutrition in the late-use (SNF) Pasture was probably much lower since most forage species had matured before cattle grazed there.

Using this year's utilization estimates, the relative preference of cattle for various forage species over the grazing season can be indicated (Tables 3.8 and 3.9). In the 1983 Saval Progress Report similar information was summarized for the preceding 4 years. Preferences for species this year were similar to those previously reported. Sandberg bluegrass on BLM pastures was again a highly preferred species during early leaf to prebloom stages. As it matured, other species became more preferred. Meadow bluegrasses were the second most preferred species in the BLM pastures and the most preferred species on NF pastures. Other meadow species (sedges and rushes) were also highly preferred on the NF pastures. These meadow species were also highly preferred in the 4 previous years. In previous years, antelope bitterbrush was more highly preferred than it was in 1984. Last year we speculated that use on bitterbrush starts when the more preferred meadow species are less available due to heavy or severe use of the Wet Meadow Range Site. Meadow species may have been available longer in 1984 due to the smaller herd size and higher forage production so cows did not switch to bitterbrush as in previous years.

Table 3.9. Relative preference (based on utilization estimates) of cattle for forage species in various phenology stages on NF native range.

Species		Phenology (early July to late August)	Species		Phenology (September)
Meadow bluegrasses (mainly Kentucky)	(1)*	Prebloom to green, cast	Meadow bluegrasses (mainly Kentucky)	(1)	Dry, cast
Sedges	(1)	Bloom to dry, cast	Sedges	(1)	Cast
Rushes	(2)	Seedripe to cast	Rushes	(2)	Cast
Spike fescue	(3)	Bloom to dry, cast	Great Basin wildrye	(3)	Seedripe to dry, cast
Great Basin wildrye	(4)	Prebloom to seedripe	Antelope bitterbrush	(3)	Green, cast
Bluebunch wheatgrass	(4)	Start bloom to seedripe	Spike fescue	(4)	Dry, cast
Idaho fescue	(5)	Bloom to seedripe	Bluebunch wheatgrass	(4)	Cast
Antelope bitterbrush	(5)	Seedripe to green, cast	Mountain brome	(4)	Cast
			Sandberg bluegrass	(4)	Cast
			Idaho fescue	(4)	Cast

*(Preference Level) - See Table 3.8

SECONDARY SUCCESSION

1984 Objectives:

1. Determine the quantity and quality of native grass seed produced.
2. Initiate research on the influence of competition, soil surface type, and simulated precipitation on emergence and establishment of grasses.

1984 Accomplishments:

Methods-Objective 1. Seed of native grasses was collected from six low- to high- elevation range sites: Loamy 8-10", Loamy 10-12", Claypan 10-12", South Slope 12-14", South Slope 14-18", and Riparian Aspen Woodland. Also, crested wheatgrass seed was collected on the East Darling Seeding. At each location, a sample consisted of five transects with five 21.5 $ft.^2$ plots/transects. Seed was air-dried and hand-thrashed. For large samples, seed was separated from chaff with a clipper mill. For small samples, seed was hand separated. Total seed weight, test weight/100 seeds, and germination were measured. These characteristics determined over time will define the variability in quantity and quality of seed in relation to climate, past grazing use (phenology and degree of use), range site, and range condition.

Seed yields for the Loamy 8-10", Loamy 10-12"; Claypan 10-12", and South Slope 12-14" range sites were collected at the same location in 1983 and in 1984. This was possible because seed was harvested prior to cattle grazing or inside exclosures. Yield of crested wheatgrass seed was sampled in different seeded pastures, however, frequency of crested wheatgrass was similar in both pastures (61% in East Darling and 57% in West Darling. Since seed yields in 1983 and 1984 were taken at the same location or on sites with similar species frequency, a direct comparison can be made between years. Seed samples for the S. Slope 14-18" and Riparian Aspen Woodland sites were collected in the NNF pasture in 1983 and in the SNF pasture in 1984 and, therefore, are not comparable. A seed sample for the Claypan 10-12" site was collected on the NNF in 1983 but no comparable range site was sampled in 1984.

Results-Objective 1. Seed yield for 1983 was given in the 1983 Annual Report, but is repeated in this Report (Table 3.10) so a comparison can be made with 1984 seed yield (Table 3.11). Germination data for each species for respective years are also presented in these two tables. Test weights for each species in 1983 and 1984 are given in Table 3.12.

On sites that are comparable between years, crested wheatgrass, Sandberg bluegrass, squirreltail, and bluebunch wheatgrass produced less seed in 1984 than in 1983. More bluegrass and squirreltail seed was produced on the Loamy 8-10" site in 1983 than on the Loamy 10-12" and Claypan 10-12" sites. In 1984, however, seed production by these species on the Loamy 10-12" and Claypan 10-12" sites was much greater than on the Loamy 8-10" site. Yield of Thurber needlegrass seed was very low in both years on the two sites where this species occurred at a sufficient density to permit sampling. Yield of bluebunch wheatgrass seed on the S. Slope 12-14" site was somewhat less in 1984 than in 1983. On all sites sampled in both years, seed produced by all

species except Thurber needlegrass on the Loamy and Claypan sites and bluebunch wheatgrass on the S. Slope 14-18" site in 1984 is probably sufficient to perpetuate the stand even if only a small number of seeds result in established plants.

Percent germination of seed in 1983 and 1984, was similar within some species on some range sites and widely different in other species on other range sites (Tables 3.10 and 3.11). Germination of Sandberg bluegrass and squirreltail seed on the Loamy 8-10", Loamy 10-12", and Claypan 10-12" sites was similar in 1983 and 1984. In 1983, germination of Sandberg bluegrass seed on the higher elevation sites was less than at lower elevations. Germination of squirreltail seed also was less on the S. Slope 12-14" site than on lower elevation sites. The very low germination of Thurber needlegrass seed in both years is probably a characteristic of this species. Very low seed production and poor germination are reasons why natural revegetation by this species can not occur in a reasonable time. Other very low seed germination values were obtained for bluebunch wheatgrass on the S. Slope 12-14" site in 1983 and on the S. Slope 14-18" site in 1984, for mountain brome on the Riparian Aspen Woodland site in 1984, and for slender wheatgrass and Kentucky bluegrass on the Riparian Aspen Woodland site in 1983. Rather high germination values for these species was obtained in different years or on different range sites. Several more years of seed production and quality data will be needed to determine the reasons for these differences. The very high germination for Great Basin wildrye seed in both years is unusual for this native species.

Table 3.12 shows some large differences in mean test weight between species and range sites. Several more years of data will be needed to determine which test weights are typical for a species and which represent unusually favorable or unfavorable growing conditions. General trends indicate larger crested wheatgrass seed in 1984 than in 1983. Sandberg bluegrass seed was of similar test weight in both years, and test weight appeared to increase with increasing elevation. Test weight of squirreltail seed generally decreased with increasing elevation except that the heaviest seed was found in 1984 on the S. Slope 12-14" site. Thurber needlegrass seed also tended to be heavier in 1984 than in 1983. Bluebunch wheatgrass seeds from the S. Slope 12-14" site were larger in 1984 than in 1983 while the reverse was true for this species on the S. Slope 14-18" site. Mountain brome seed was heavier in 1984 than in 1983 on the S. Slope 14-18" and on the Riparian Aspen Woodland sites. Spike fescue seed was heavier in 1984 than in 1983 on the S. Slope 14-18" site.

<u>Methods-Objective 2, Study 1</u>. The purpose of this study was to evaluate the potential for natural secondary succession on low- and high-elevation range sites. This information can be used to interpret results of trend studies and to design future studies on factors affecting seedling emergence and survival, and plant establishment.

Table 3.10. Mean seed yield (lb/ac) and percent germination (in parentheses) by species on seven range sites and a seeding in 1983.

Range site or seeding	Species[1]									
	Agde	Posa	Sihy	Stth	Agsp	Elci	Brma	Feid	Heki	Agtry	Popr
West Darling Seeding	23.3 (60)										
Loamy 8-10"		41.5 (88)	9.3 (94)								
Claypan 10-12"		34.2 (90)	6.4 (93)	0.2 (19)							
Loamy 10-12"		16.5 (88)	6.8 (90)	0.3 (3)							
South Slope 12-14"		23.4 (81)	6.9 (50)		3.3 (44)	0.8 (71)					
Claypan 12-16"		13.5 (67)									
South Slope 14-18"		0.1 (56)	0.2 (92)		1.4 (84)		2.2 (91)	3.3 (62)	2.5 (64)		
Riparian Aspen Woodland							3.0 (94)			8.5 (8)	1.0 (39)

[1] See Appendix 2 for species symbols with scientific and common names.

Table 3.11. Mean seed yield (lb/ac) by species on six range sites and a seeding in 1984.

Range site or seeding	Species[1]										
	Agde	Posa	Sihy	Stth	Agsp	Elci	Brma	Feid	Heki	Agtry	Popr
East Darling Seeding	4.9 (96)										
Loamy 8-10"		0.8 (87)	1.6 (86)								
Claypan 10-12"		9.7 (88)	4.1 (75)	0.2 (11)							
Loamy 10-12"		7.6 (88)	2.7 (60)	0.5 (8)							
South Slope 12-14"		1.9 (87)	1.8 (97)		1.8 (91)	4.8 (70)					
South Slope 14-18"					0.1 (25)		8.6 (8)	2.1 (59)	2.0 (59)		
Riparian Aspen Woodland							4.1 (68)			10.6 (65)	5.1 (78)

[1] See Appendix 2 for species symbols with scientific and common names.

Table 3.12. Mean test weight of seed (gm per 100 seeds) by species collected on six range sites and a seeding 1983 and 1984.

Range site or Seeding	Species[1]							
	Agde		Posa		Sihy		Stth	
	1983	1984	1983	1984	1983	1984	1983	1984
East Darling Seeding	0.160	0.222						
Loamy 8-10"			0.038	0.033	0.193	0.198	--	--
Claypan 10-12"			0.044	0.032	0.199	0.199	0.230	0.264
Loamy 10-12"			0.046	0.032	0.132	0.186	0.160	0.288
	Posa		Agsp		Sihy		Elci	
South Slope 12-14"	0.052	0.044	0.159	0.258	0.177	0.336	0.290	0.253
	Brca		Feid		Agsp		Heki	
South Slope 14-18"	0.573	0.659	0.078	0.088	0.243	0.101	0.161	0.258
	Agtr		Brca		Popr			
Aspen Woodland	0.345	0.394	0.656	0.807	0.024	0.024		

[1] See Appendix 2 for species symbols with scientific and common names.

Species emergence and survival on different soil-surface types were determined on six range sites. Loamy 8-10", Loamy 10-12", Claypan 10-12", S. Slope 12-14", S. Slope 14-18", and Loamy Slope 16+". Four of the following species were planted on each site: crested wheatgrass, bluebunch wheatgrass, bottlebrush squirreltail, Thurber needlegrass, Great Basin wildrye, Idaho fescue, or spike fescue. In October 1983, 100 seeds of each species were broadcast on separate 0.25 ft^2 plots of either coppice or interspace soil and mixed with the surface half inch of soil. Seedling density was determined on four dates from mid-May or early June to mid August 1984 on the four lower elevation sites and on three dates from July to August on the two higher elevation sites. Experimental design at each site was either a 4x2x4 or a 3x2x4 factorial with 10 replications. Seedling density at each sample date at each site was analyzed by a 3-factor analysis of variance with significant ($P \leq 0.05$) treatment means determined by Duncan's multiple range test.

Results-Objective 2, Study 1. Seedling densities in 1984 from fall 1983 seeding are given in Table 3.13. Seedling mortality occurred throughout the summer and resulted in densities of all species that were significantly less on the latest sampling date than on the earliest sampling date. Significantly lower seedling densities on the Loamy 8-10", Loamy 10-12", Claypan 10-12" sites on the second sampling date than on the first sampling date indicate that seedling mortality occurred rapidly between mid-May and late June. Seedling densities remained unchanged through August on the Loamy 10-12" and the Claypan 10-12" sites. Seedling density on the Loamy 8-10" site, however, decreased significantly from July 19 to August 16. These results suggest that the potential for secondary succession is less on the driest of the lower elevation range sites.

In contrast to the three lower elevation sites, seedling densities on the S. Slope 12-14", S. Slope 14-18" and Loamy Slope 16+" sites did not decrease significantly until mid-August. This lack of seedling mortality in early summer is probably related to greater precipitation, higher soil moisture holding capacity, and lower evapotranspiration at higher elevation sites than at lower elevation sites.

Seedling density was similar on the coppice and interspace soil surfaces on the Loamy 10-12" and Loamy 16+" sites. On all other sites, significantly more seedlings occurred on the coppice soil than on the interspace soil. On the two sites with no difference in density between soil surfaces, there is visually only small differences beween coppice or interspace soils. On sites with a difference in seedling densities between surface soils, coppice soils are darker, more friable, and have less gravel than do the lighter colored, crusted, and gravel-surfaced interspace soil. The difference in seedling density between the two soil surfaces occurred on the early and late sample date on the Loamy 8-10" site and on all dates on the Claypan 10-12", S. Slope 12-14", and S. Slope 14-18" sites.

Seedling densities of Thurber needlegrass and crested wheatgrass were similar and were significantly greater than were densities of squirreltail and bluebunch wheatgrass on the Loamy 8-10" site. Also needlegrass, crested wheatgrass, and squirreltail densities were greater on coppice soil than on interspace soil. On the Loamy 10-12" site density of needlegrass seedlings

Table 3.13. Mean seedling density/0.25 ft^2 in spring and summer of 1984 on six range sites in response to sample date, soil surface type, and species. Seed was planted in fall 1983.

Range Site	Main effects										
	Sample date		Soil-surface type		Species[1]						
	early (May-June)	late (Aug)	Coppice	Interspace	Agde	Stth	Sihy	Agsp	Elci	Feid	Heki
Loamy 8-10"	8.8a	3.2b	7.9a	3.7b	9.2a	7.9a	3.2b	2.2b	--	--	--
Loamy 10-12"	7.7a	3.2b	4.6a	4.6a	5.6b	9.1a	1.7c	2.0c	--	--	--
Claypan 10-12"	11.5a	4.4b	9.9a	3.7b	9.8a	9.9a	4.0b	3.6b	--	--	--
S. Slope 12-14"	2.4a	1.3b	2.9a	1.1b	--	5.5a	0.4c	1.6b	0.5c	--	--
S. Slope 14-18"	1.3a	0.4b	1.2a	0.6b	--	--	--	0.9a	1.0a	0.6a	1.1a
Loamy Slope 16+"	1.6a	0.5b	1.1a	1.2a	--	--	1.4ab	1.0bc	0.5c	1.6a	--

[1] See Appendix 2 for species symbols with common and scientific names.

[2] Seedling density means for each main affect within a range site followed by the same letter are not significantly different ($P \leq 0.05$).

was significantly greater than for crested wheatgrass. Densities of both species were greater than for squirreltail and bluebunch wheatgrass. Emergence of all species was similar on coppice and interspace soil. On the Claypan 10-12" site, seedling densities of needlegrass and crested wheatgrass were similar and were greater than for squirreltail and bluebunch wheatgrass. Needlegrass, crested wheatgrass, and squirreltail all had more seedlings on coppice soil than on interspace soil. On the S. Slope 12-14" site, needlegrass had the highest seedling density followed by bluebunch wheatgrass. Squirreltail and Great Basin wildrye had the lowest densities. More seedlings of bluebunch wheatgrass, needlegrass, and wildrye were found on coppice soil than on interspace soil. Seedling densities of all species planted on the S. Slope 14-18" site were similar and seedling density of all species was greater on coppice soil than on interspace soil. On the Loamy 16+" site, Idaho fescue and squirreltail had the highest seedling densities followed by bluebunch wheatgrass and Great Basin wildrye. Bluebunch wheatgrass, squirreltail, and Idaho fescue had similar seedling densities on coppice and interspace soils while more wildrye seedlings were found on interspace soil.

Methods-Objective 2, Study 2. The purpose of this study was to evaluate the effects of brush competition, soil-surface type, simulated precipitation and season of emergence on emergence, survival and establishment of four grass species. The study was conducted on three range sites: Loamy 8-10", Loamy 10-12", and Claypan 10-12". All shrubs were removed from one set of plots in late July (Fig. 3.2). In each replication of each brush treatment, four, 1 ft^2

Figure 3.2. Secondary succession study area on the Loamy 10-12" Range Site in Upper Mahala Pasture showing check and cleared areas.

plots were randomly located on coppice soil and four plots were located on interspace soil. Four precipitation treatments were randomized on each of these soil surface plots. These were: Control (C) - natural precipitation falling from mid-August to the end of September 1984. Base (B) - simulated precipitation equal to that received from mid-August to the end of September 1983 and which resulted in some seedling emergence in that year; 1.5 B = 1.5 x the Base amount; and 2.0 B = 2.0 x the Base amount. The probability of the amount of precipitation represented by these treatments falling in any 1-week period is shown in Table 3.14. Each plot was subdivided into four randomly selected subplots of 0.25 ft^2. Crested wheatgrass, bluebunch wheatgrass, bottlebrush squirreltail, and Thurber needlegrass were seeded during the period August 1-9, 1984 to evaluate fall emergence. Gypsum soil moisture blocks were buried at depths of 1, 2, 4, and 6 inches on two of six replications prior to seeding. Seed was broadcast on the soil surface and mixed with the surface half inch of soil. Experimental design within each brush treatment was a 2x4x4 factorial with six replications. Simulated precipitation treatments were initiated on August 16th and were continued until September 28th at 1- to 8-day intervals depending upon treatment. A measured amount of water was applied from a sprinkler can over a plot frame that minimized movement of surface water among subplots and from the inside of the plot to the outside of the plot (Fig. 3.3). Soil moisture readings were determined every 3 to 4 days with a soil moisture meter and the readings were converted to bars of soil moisture tension. Seedlings were counted periodically from August 20 through October 4. Seedling density from the October 4 count on each brush treatment on the Loamy 10-12" range site was analyzed by a 3-factor analysis of variance with significant ($P \leq 0.05$) treatment means determined by Duncan's multiple range test. A sample of seedlings present on all plots at the three study sites on October 23 and 24 were marked with toothpicks to determine winter survival.

Figure 3.3. P. Slaton applying simulated precipitation treatments on a Claypan 10-12" Range Site in Middle Mahala Pasture. Photo by D.W. Stager.

Table 3.14. The relation between natural and simulated precipitation treatments and the probability of weekly precipitation amounts for August and September.

For week beginning	Loamy 8-10"				Loamy 10-12"				Claypan 10-12"			
	Simulated precipitation treatment[1]											
	C	B	1.5B	2.0B	C	B	1.5B	2.0B	C	B	1.5B	2.0B
	Probability %[2]											
Aug 9	10	14	14	14	10	14	5	5	9	12	12	12
Aug 16	21	68	68	8	21	<1	<1	<1	68	1	1	<1
Aug 23	36	64	6	<1	10	<1	<1	<1	64	<1	<1	<1
Aug 30	3	6	<1	<1	11	<1	<1	<1	6	60	60	<1
Sept 6	43	8	8	2	64	2	2	<1	64	1	<1	<1
Sept 13	27	2	2	2	63	<1	<1	<1	19	15	5	<1
Sept 20	35	20	20	20	20	10	3	2	35	10	2	2
Sept 27	11	23	23	11	13	23	23	5	8	48	48	23

1 C = Control - natural precipitation for each weekly period in August-September, 1984.
B = Base - simulated precipitation equal to that for each weekly period in August-September, 1983.
1.5B = simulated precipitation equal to 1.5 times the Base.
2.0B = simulated precipitation equal to 2.0 times the Base.

2 Based on NOAA climatological records for Elko, NV.

The entire study was repeated in late October to provide spring emerged seedlings for spring-summer evaluation of the same brush competition, soil surface types, and species. Simulated precipitation treatments will be different: C-spring-summer, 1985 precipitation; B-spring-summer, 1984 precipitation which resulted in some seedling survival through August 1984; 1.5 B; and 2.0 B. The sequence of experiments will be repeated in August 1985 and in October 1985.

Results- Objective 2, Study 2. Fall seedling emergence of four species in response to soil-surface type and simulated precipitation was determined for the Loamy 8-10", Loamy 10-12", and Claypan 10-12" sites. On the Loamy 8-10" and Claypan 10-12" sites seedling emergence of all species was very low, erratic among treatments and the plumules of grass seedlings were barely visible in October. The amount of water applied ranged from 0.2 to 1.5 in/wk and approximated a 60 years in 100 years precipitation event to a 1 year in a 100 years precipitation event for a given weekly period. This amount of simulated precipitation, in relation to high evapotranspiration and crusting soil surface, was not sufficient to obtain uniform seed germination, seedling emergence, or seedling growth and development. On the higher elevation and more mesic Loamy 10-12" site, seedling emergence was noted on August 20. By October 4, seedlings were from 0.5 to 6 inches tall and had from 1 to 17 leaves. The amount of simulated precipitation added ranged from 0.2-1.1 in/wk and approximated a 23 years in 100 years precipitation event to a 1 year in 100 years or more precipitation event for a given weekly period. This amount of added precipitation in relation to lower evapotranspiration, and non-crusting soil surface probably accounts for this differential response.

The effects of treatment main effects (brush competition, soil-surface type, simulated precipitation, and species) on density of emerged seedlings are given in Table 3.15. With brush competition, more seedlings emerged on the coppice soil. Without brush competition emergence was similar on both soil surfaces. With brush competition, no seedlings emerged on the Control treatment but the Base and Base x 1.5 treatments both resulted in an increase in seedling density, and the Base x 2.0 resulted in the most seedlings. Without brush, the Control treatment resulted in a few seedlings; the Base treatment gave a significant increase in seedling density, and seedling densities on the Base x 1.5 and Base x 2.0 treatments were similar and were significantly greater than on the Control and Base treatments. Both with and without brush competition, density of crested wheatgrass was significantly greater than for the other three species. Although the differences in seedling densities between brush treatments were not analyzed statistically, most comparisons show numerically more seedlings on each of the main-effect treatments on plots without brush (Table 3.15). For example, more seedlings on both coppice and interspace soil without brush competition; more seedlings on the Control and on all simulated precipitation treatments without brush; and more seedlings of each species without brush. With brush competition, no significant interaction occurred among treatments. This suggests that brush competition was a dominant factor that prevented the full expression of other treatments. Conversely, without brush, both soil-surface type and species interactions with simulated precipitation were significant. For example, better emergence occurred on the Base, Base x 1.5, and Base x 2.0 simulated precipitation treatments when

Table 3.15. Mean seedling density/0.25 ft^2 in October 1984 on the Loamy 10-12" range site in response to brush competition, soil surface type, simulated precipitation, and species main effects. Seed was planted in August 1984.

Competition level	Main effects			
		Soil-surface type		
		Coppice	Interspace	
With brush		2.9 a[1]	0.8 b	
Without brush		3.2 a	2.9 a	
		Simulated precipitation treatment		
	Control	Base	1.5B	2.0B
With brush	0.0 c	2.5 b	2.0 b	3.1 a
Without brush	0.7 c	2.3 b	5.2 a	4.1 a
		Species		
	Crested wheatgrass	Bluebunch wheatgrass	Squirreltail	Thurber needlegrass
With brush	3.1 a	1.7 b	1.3 b	1.4 b
Without brush	4.6 a	3.4 b	2.2 b	2.1 b

[1] Seedling density means within each brush treatment of each main effect followed by the same letter are not significantly different ($P < 0.05$).

[2] Control = August and September 1984 precipitation.
Base = August and September 1983 precipitation.
1.5B = 1.5 x Base amount.
2.0B = 2.0 x Base amount.

applied to the coppice soil than when these treatments were applied to the interspace soil. Also crested wheatgrass responded to the Base, 1.5 x Base, and 2.0 x Base treatments; Thurber needlegrass responded to the Base x 1.5 and Base x 2.0 treatments, and squirreltail and bluebunch wheatgrass responded only to the Base x 2.0 x treatment.

An example of the influence of sagebrush competition on soil moisture extraction can be seen in table 3.16. Both brush treatments received 0.5 inch of simulated precipitation 8 days before soil moisture measurements were made. After 8 days, the very high soil moisture tensions on plots with brush would prevent most physiological functions such as seed germination or shoot and root growth of seedlings. The very low soil moisture tensions on plots without brush would permit various physiological functions. Also, the low tensions at a 1-inch depth on the Base x 1.5 and Base x 2.0 treatments would be most favorable for germination of seed placed in the soil surface.

Results obtained on the Loamy 8-10" and Claypan 10-12" sites suggest that even with a seed source, the probability of secondary succession through the mechanism of fall emergence would be an extremely rare occurrence. Results from the Loamy 10-12" site suggests that low probability precipitation events will result in episodic seedling emergence in the fall when competitive herbaceous vegetation is dormant. If these plants can survive the winter and begin growth early in the spring, establishment may be possible if roots can maintain contact with moist soil layers as soil moisture is depleted by competing woody and herbaceous vegetation.

Table 3.16. Soil moisture tensions (bars) on 9/4/84 at four depths on coppice soil on the Loamy 10-12" site in relation to brush treatment and simulated precipitation treatments.

Simulated precipitation treatment[1]	Depth (in)	With brush	Without brush
Control	1	15.0	15.0
	2	11.8	2.0
	4	15.0	1.0
	6	15.0	0.5
Base	1	15.0	3.5
	2	9.2	1.0
	4	13.5	0.7
	6	7.0	0.5
1.5B	1	10.5	1.0
	2	3.5	0.2
	4	6.5	0.5
	6	10.5	1.0
2.0B	1	15.0	0.5
	2	15.0	0.2
	4	13.5	0.3
	6	15.0	0.3

[1] Control = August and September 1984 precipitation
Base = August and September 1983 precipitation
1.5B = 1.5 x Base amount
2.0B = 2.0 x Base amount.

Literature Cited

Hyder, D .N. and F. A. Sneva. 1954. A method for rating the success of range seeding. J. Range Management 7:89-90.

Winward, A. H. and G. C. Martinez. 1983. Nested frequency...an approach to monitoring trend on rangeland and understory timber vegetation. p. 632-635. In Renewable Resource Inventories for Monitoring Changes and Trends. Proc. of International Conference, Aug. 15-19, 1983. Corvallis, OR.

Chapter 4

SAGE GROUSE RESEARCH

Gary N. Back, Mack R. Barrington and J. Kent McAdoo

POPULATION DYNAMICS

1984 Objective:

Monitor sage grouse population parameters.

1984 Accomplishments:

Population dynamics were monitored with strutting ground counts and hunter harvest data. Strutting ground counts were conducted from 21 March through 18 May using the Patterson census technique. Counts were conducted between sunrise and 0700 local time. Hunter harvest data were collected in a cooperative effort with Nevada Department of Wildlife (NDOW). A check station was operated 8-9 September on the Mountain City Highway. Data collected included: number of hunters, number of hunter-days, number of birds bagged, and sex of birds bagged. A wing was collected from each bird for age and production determination.

The estimated number of male sage grouse in 1984 was 98. Based on a 40:60 male:female sex ratio, the estimated total population was 245 sage grouse. This was a 19% decline from 1983 (Table 4.1). The period of peak attendance occurred during the first two weeks in May.

Data collected in Colorado (Hupp, unpublished report to North American Grouse Group, 1984) suggest that the initiation of strutting, intensity of display, and attendance of individual males at the grounds are influenced by the physical condition of males in spring. In particular, energy reserve levels appear to influence strutting activity. The level of energy reserves is a result of the interaction of late winter energy demands and the quality of available forage during that period. Therefore, the assumption that a complete or nearly complete count of males can be made at strutting grounds may be invalid, at least in some years. If the variability between years in the proportion of males that strut is great, then the technique may not even provide an index to population trends.

The apparent decline in sage grouse numbers on the Saval study area since 1979 (Table 4.1) may not reflect the actual population performance as it is based on strutting ground counts. No weight data (a gross indicator of energy reserves) have been obtained during the strutting period at Saval in past years, so there is no way to evaluate the reliability of the strutting ground count data.

Strutting ground counts are planned for 1985, but with the current level of staffing, nightlighting to obtain pre-strutting and post-strutting live weights is not possible.

Only 25 hunters checked at the check station hunted on or near the Saval Project study area. They bagged only 10 birds. This sample was too small to estimate sex and age ratios or breeding success of females. Data from all of Area 6 (which includes the Project area) was not available from NDOW at the time of this report (Paul Lucas, personal communication). The estimate of production and other population parameters for 1984 will be included in the next Progress Report.

No bands were turned in during the 1984 hunting season.

HABITAT UTILIZATION

1984 Objectives:

1. Determine the feasibility of initiating studies of sage grouse response to timing and intensity of grazing on meadows.

2. Identify and quantify habitats used in winter and identify climatic factors that influence movements and/or habitat selection.

1984 Accomplishments:

Response to Grazing Meadows -

The modeling effort identified riparian areas as having the greatest probability for evaluating the impact of the grazing system on sage grouse production and survival. Specifically, the meadows provide succulent forage for sage grouse broods in summer and for adults in late summer. The phenology and protein levels of the forage can be affected by grazing intensity and timing. Grazing practices might also influence species composition.

Therefore, a feasibility study was conducted to: 1) identify meadows suitable for a research project, b) determine the extent of sage grouse use of meadows, c) test field methods for evaluating sage grouse use of meadows, and d) determine if livestock use of the meadows coincided with the grazing schedule. Fifteen meadows were selected from aerial photographs based on size and type of meadow (long, narrow stringer meadows, broad, "flood plain" meadows, and meadows associated with springs).

Flushing counts were conducted on each meadow from 11 July to 14 September. Meadows were sufficiently narrow that it was judged that one person could effectively flush any grouse present by walking down the middle of the meadow. However, most often the flushing counts were conducted in pairs with each person responsible for one-half the meadow width. Before entering the meadows, observers viewed the meadows with binoculars and recorded any grouse seen for comparison with the flushing counts. Data recorded during counts included: date, time of day, number of adults, number of immatures, whether or not cattle were present, and whether or not the meadow had been grazed.

A total of 170 counts were conducted. A flushing rate of one flush per 11.3 counts and an average of 3.5 birds per observation were obtained. The flushing rate of 50 counts conducted between local sunrise and 0900 and 104 counts conducted between 0900 and 1700 were the same; 0.1 flushes per count. No birds were observed during 16 counts conducted between 1700 and sunset. Sage grouse were observed on only six of the 15 meadows.

The flushing count technique appeared to work well on the narrow meadows selected for this study. However, it is labor intensive and should be used in conjunction with radio-collared birds to further evaluate its reliability.

Unauthorized livestock use was observed on several meadows. This would severely confound any experimental design for evaluating the impact of the scheduled grazing on phenology and protein content of the vegetation.

As a result of the feasibility study, no further research on sage grouse response to livestock grazing of meadows is planned. Problems with unauthorized livestock use and the lack of available funding for creating experimental exclosures/enclosures to resolve the unauthorized use problems, combined with the limited use of the selected meadows by sage grouse, make the probability of success extremely poor.

Winter Habitat Use -

A winter habitat use and movement study was initiated in October, 1982 and continued in winters 1983-84 and 1984-85. Data collection has been completed. The analysis and results of the study will be completed by August, 1985 and two manuscripts for publication are planned.

A pilot study of the allelochemical composition and content of the three subspecies of _Artemesia tridentata_ (_A.t. tridentata_, _A.t. wyomingensis_, and _A.t. vaseyana_) and _Artemesia longiloba_ was initiated in October, 1984. Leaf samples for chemical analysis from the various taxa were collected from October through March. The results of the chemical analysis (liquid gas chromatography) will be available by May, 1985. A manuscript for publication should be completed by July 1985. Depending on the results of the pilot study, additional research on sagebrush physiology and sage grouse forage selection will be conducted.

HABITAT AVAILABILITY

1984 Objectives:

1. Prepare the final vegetation maps for BLM and private lands of the study area.

2. Initiate mapping of the National Forest lands.

3. Design a sampling scheme to quantify vegetation parameters for the vegetation types already mapped.

1984 Accomplishments:

A vegetation map of BLM and private lands was completed and copies have been distributed to project participants.

The mapping of the National Forest lands was not initiated in 1984. The time was allocated to a low-altitude aerial photography mission (see Chapter 9) and the high quality aerial photography of the National Forest lands thought to be available was not obtained. One portion at the head of Mahala Creek was mapped (see Chapter 8). Due to budget reductions and the consequent loss of one full-time position, the remaining vegetation mapping could not be completed.

The characterization of the vegetation units already mapped will not be done systematically as originally planned. The loss of personnel requires that quantification efforts be limited to those vegetation types used by sage grouse and of high priority to sage grouse research.

Acknowledgements

The senior author of this chapter wishes to personally thank Mack Barrington for his help and patience with me since my arrival in 1982. He helped me learn the plant species and vegetation types, taught me many of the telemetry tricks, and shared the joys and frustrations of trying to do research, often under adverse conditions (the winter of 1983-84 comes immediately to mind). His expertise in many areas and quiet manner will be sorely missed. Many thanks and sincere best wishes.

Two other co-workers and friends chose to leave the project; John Barber and J. Kent McAddo. Both have left their mark on the project and the people that remain. I wish them both good fortune and offer thanks for their help, counsel, and comradery.

Table 4.1. Sage grouse population estimates and date of peak male attendance at strutting grounds, 1979-1984.

	Year					
	1979	1980	1981	1982	1983	1984
Males (counted):	269	181	157	107	121	98
Date of peak:	--	4/18 -5/1	4/17 -5/1	4/18 -5/8	5/3- -5/20	5/8- 5/17
Females (calculated):	404	272	203	161	182	147
Total:	673	453	393	268	303	245

CHAPTER 5

MULE DEER STUDIES

PART 1: THE INFLUENCE OF CATTLE GRAZING ON MULE DEER DIETS AND HABITAT IN ASPEN COMMUNITIES OF NORTHEASTERN NEVADA

Thomas E. Morrell and Donald A. Klebenow

1984 Objectives

Initiate a two-year study which will evaluate the effect that cattle grazing in aspen (*Populus tremuloides*) communities has on mule deer (*Odocoileus hemionus*) diets and habitat. The objectives include: (1) evaluate the effect of cattle grazing in the aspen community on mule deer forage selection, (2) evaluate the nutritional quality of forages selected by mule deer on grazed and non-grazed aspen areas, and (3) evaluate the effect of cattle activity on potential mule deer hiding cover in the aspen community.

Study Area

The study area is located near the headwaters of Stump Creek on the north pasture of the Forest Service East Independence Grazing Allotment. The site is characteristic of young to mid-age aspen stands on the Saval. A dense aspen canopy of 50 to 80% occurs on the study site with a lush understory of shrubs and forbs. Some grasses also occur there.

1984 Accomplishments

Deer diets were evaluated in four 3/4-acre pens using the bite count technique (Wallmo and Neff, 1970) on two tame female deer. Two of the pens represented the north pasture of the Forest Service grazing allotment and two pens represented the south pasture. One of the two pens in each group was grazed by cattle while the other was used as a control. Three fistulated yearling cattle grazed intermittently in pen 2 from July 26 to August 13 to simulate the 1984 north pasture grazing period and in pen 3 from August 13 to September 4 to simulate the 1984 south pasture grazing period. A 50-70% utilization of grasses was realized in the grazed pens.

A deer foraging period consisted of sampling each deer four times in each pen (8 deer hours/pen). Feeding trials lasted 60 minutes per deer and took place in the early mornings and late afternoons. Deer foraging periods took place before, during, and after cattle grazing treatments. During non-sample periods, the deer were fed a ration of alfalfa pellets and rolled oats.

The deer food habits were summarized for pen and treatment for all plant species eaten during a feeding trial. Over 50,900 bites of 8 grass, 52 forb, and 8 shrub (including aspen) species were recorded during 1984. Tables 5.1 and 5.2 display those plants which made up 2% or more of the total bites taken by both deer in a pen during any one foraging period.

Table 5.1. Total bites taken by two mule deer of species making up > 2% of the diet during any one treatment trial for the north pasture pens.

	Deer Forage Periods							
Species	July 16 - 26		August 1 - 11		September 1 - 11		October 12 - 16*	
Shrubs:	Control Pen	Before Grazing Pen	Control Pen	During Grazing Pen	Control Pen	After Grazing Pen	Control Pen	After Grazing Pen
AMUT	150	78	144	89	264	54	1	17
RICE	99	146	21	63	148	82	213	443
ROWO	10	-	-	20	16	73	40	14
SYOR	192	152	132	608	355	614	259	474
POTR	34	116	144	212	298	412	401	419
Forbs:								
AGUR	7	3	26	63	15	9	14	49
AIBI	64	23	11	-	-	-	-	-
ASOC	107	118	390	96	658	417	31	70
CAMI	57	120	92	79	53	33	8	-
COLI	21	27	11	13	38	102	-	-
GEVI	403	389	396	110	537	270	9	1
HAMI	213	279	196	101	292	182	2	-
LIHA	117	106	-	18	14	6	-	-
OSOC	3	13	10	15	39	62	35	41
PEBO	7	601	-	429	-	-	-	-
PODO	8	100	183	413	658	2534	-	11
POGL	417	155	567	142	394	246	43	11
STJA	38	50	74	50	11	4	-	-
VAAC	494	227	405	170	16	34	-	-
VINU	66	89	22	2	3	1	-	-

*Pens were sampled for 4 deer hours

Table 5.2. Total bites taken by two mule deer of species making up > 2% of the diet during any one treatment trial for the south pasture pens.

Species	Deer Forage Periods							
	July 16 - 26		August 1 - 11		September 1 - 11		October 12 - 16	
	Before Grazing Pen	Control Pen	Before Grazing Pen	Control Pen	During Grazing Pen	Control Pen	After Grazing Pen	Control Pen
Shrubs:								
AMUT	100	41	116	265	72	541	18	41
RICE	156	115	40	7	236	3	485	199
SYOR	268	132	433	175	1098	505	315	381
POTR	353	131	328	244	572	311	635	324
Forbs:								
AGUR	3	2	68	78	35	3	47	29
ALBI	175	195	9	9	–	–	–	–
ASOC	109	92	1201	236	64	7	3	–
CAMI	74	250	18	205	16	160	–	22
COLI	12	28	84	107	3	97	–	–
ERUM	60	98	79	128	8	175	–	32
GEVI	315	378	403	253	70	222	9	–
HAMI	303	333	279	428	326	300	8	–
LIHA	4	2	139	–	3	8	–	–
OSOC	11	5	6	–	88	6	118	37
PEBO	86	118	132	12	–	–	–	–
PODO	9	10	686	964	132	2265	–	–
POGL	169	1	91	6	53	10	–	2
STJA	135	193	304	195	2	17	–	–
VAAC	230	66	289	59	6	2	–	–
VINU	112	135	107	79	–	2	–	–
WYAM	79	183	105	382	–	80	–	18

*Pen 3 (grazed pen) was sampled for 6 deer hours and pen 4 (control pen) for 4 deer hours

Forage species were lumped into major plant groups (grass/grasslikes, forbs, and shrubs) and the percent of bites taken in the grazed and non-grazed pens were compared (Table 5.3). There were no significantly noticeable differences in consumption percentages of plant groups between the two un-grazed control pens (1 and 4) for any sample period.

The results indicate a preference for forbs throughout the summer until the October sample when shrub consumption became most important. Cattle grazing seemed to have the greatest effect on the "during" sample periods where fewer total bites were taken by the deer and forb use decreased compared to the control pens (Table 5.4). In pen 2, the early grazed pen, forb use declined, but remained high at 64% of the total bites during the grazing period. This was considerably lower than the forb use in the two ungrazed pens for the same period. Similarly, in pen 3, the late grazed pen, forb use was dramatically lower during the grazing treatment than in the non-grazed pens.

During the "grazing periods" the deer often approached, smelled or tasted, and then rejected a potential food item. This occurred many times, especially when cattle were in the pen with the deer during a sample. In contrast, food rejection was seldom seen in a non-grazed pen.

Forb use during the grazing treatment was greater for the early grazed pen 2 (1804 bites) than for the late grazed pen 3 (946 bites) which was grazed later in the season. Forb use regained importance in the deer diet in the early grazed pen for the post-graze period, making up 73% of the total bites taken. This was comparable to forb use in ungrazed pens 1 and 4 for the same period where forbs made up 72% and 73% of the diets respectively. An increase in forb use was not observed for the post-graze period in the late grazed pen. However, there was a noticeable decline in forb use in all of the pens for this sample period. This was probably due to forb senescence resulting in reduced availability.

The results also suggest that grazing and the timing of grazing (early vs. late) may affect the use of certain preferred forb species (Fig. 5.1 and 5.2). Sticky geranium was one of the most frequently eaten plants during the pre-graze trials in pens 1 and 2, making up 15% and 13% of the total bites eaten in each pen. Similarly in pens 3 and 4 geranium was important during both pre-graze periods. During the grazing period, geranium use in pen 1 remained high at 12% of the diet, but in grazed pen 2 dropped to 4%. Although not as contrasting, similar results occurred in the late grazed southern pens. Here geranium use fell to 2% of the diet in the grazed pen versus 4% use on the non-graze area for the "during" sample period.

For the post-graze period the use of geranium remained low in early grazed pen 2, at 5% whereas in control pen 1 use continued to remain high at 13% of the bites taken. Only a trace of geranium was taken during the post-graze period in the southern pens.

There were also noticeable differences in the selection of western aster (Aster occidentalis) between grazed and ungrazed pens in the northern pens where use was much lower for the during and after foraging periods (Fig. 5.2).

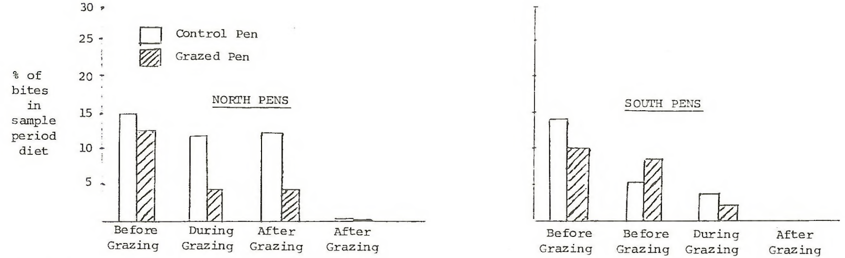


Fig. 5.1 Contribution (%) of Geranium viscosissimum to the total number of bites for a sample period in the north and south pasture pens.

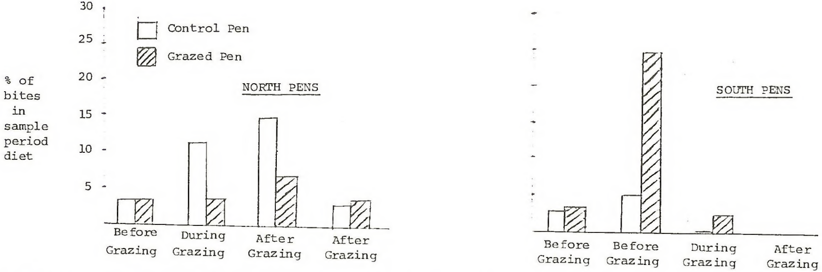


Fig. 5.2 Contribution (%) of Aster occidentalis to the total number of bites for a sample period in the north and south pasture pens.

Table 5.3. The effect of grazing treatments on number of bites taken from major plant groups by tame mule deer in aspen habitat.

Pen	Plant Group	SAMPLE PERIODS: July 16-26 # of Bites	(%)	August 1-11 # of Bites	(%)	September 1-11 # of Bites	(%)	October 12-16* # of Bites	(%)
Ungrazed Control (#1)	Grass	3	T	27	1	91	2	57	4
	Forbs	2232	82	2733	85	3058	72	296	23
	Shrubs	489	18	441	14	1085	26	927	72
Total		2721		3204		4235		1206	
Early Grazed (#2)	Grass	5	T	8	T	166	3	15	1
	Forbs	2556	84	1804	64	4174	73	241	15
	Shrubs	495	16	1002	36	1402	24	1388	84
Total		3056		2818		5744		1644	
Late Grazed (#3)	Grass	7	T	9	T	4	T	0	0
	Forbs	2342	81	4101	81	946	32	297	17
	Shrubs	524	18	917	18	2017	68	1496	83
Total		2873		5036		2980		1793	
Ungrazed Control (#4)	Grass	7	T	21	T	68	1	4	T
	Forbs	2211	84	3303	81	3807	73	207	13
	Shrubs	420	16	740	18	1369	26	1436	87
Total		2638		4064		5245		1647	

*Pens 1,2,4 sampled for 4 deer hours, pen 3 sampled 6 deer hours

As forb availability and use declined through the season, shrub use increased. Snowberry (Symphoricarpos oreophilus) was the most heavily used shrub by deer for all sample periods. Wax current (Ribes cereum) was also a favored shrub food source. When available, the flowers and fruits of snowberry and current were chosen. During the October sample period, there appeared to be more ripened berries per plant in the ungrazed pens than in the grazed pens. This is believed to result from the selection of flowers by the cattle during grazing bouts.

Serviceberry (Amelanchier utahensis) seemed to be a highly desired species, but occurred as only a trace in each pen.

The use of aspen by deer generally increased through the sample season like that of shrubs, and its use also increased during grazing periods. Young aspen suckers, dried fallen leaves, and leaves from broken or downed aspen branches were selectively eaten. Mature green leaves on unbroken branches and trees were avoided.

Grasses were not an important constituent of the deer diets, contributing to no more than 4% of the total bites taken during any sample period. Cattle grazing did not appear to affect the use of grasses by deer.

We have not yet analyzed deer forage samples from 1984 for nutritional value.

The Influence of Cattle on Horizontal Cover

Using a vegetation profile board, differences in potential mule deer hiding cover was evaluated between grazed and nongrazed pens. The board is 1.5m high by 25cm wide. It is marked in alternate colors, black and white, at 30cm intervals.

Horizontal cover was recorded from a distance of 15m at 40 randomly placed points within each pen. The proportion of 30cm intervals covered by vegetation was recorded as a single digit "density score" which corresponded to the mean value of a range of quintiles (Nudds 1977).

To date, only the two lowest intervals (0-30cm and 30-60cm) have been analyzed by computing mid point cover averages for these two intervals. The average of the two cover readings was used for analysis.

No significant differences ($P < 05$) were observed between the grazed and nongrazed pens in either north or south pasture pens for the pregraze periods (Table 5.4). Following grazing treatments highly significant differences ($P < .01$) were recorded between control pen 1 and early grazed pen 2. Significant differences were realized between late grazed pen 3 and control pen 4 at the 0-60cm interval level.

Conclusions

The results are preliminary and based upon one year of research. The differences in forb and shrub selection between grazed and ungrazed pens suggest that cattle grazing in aspen communities does have an effect on mule deer forage selection. The variation in horizontal cover between grazed and ungrazed pens suggests that grazing may also influence potential mule deer hiding cover in aspen.

Table 5.4. Differences in vegetative horizontal cover at the 0-60 height level between grazed and non-grazed pens.

	North Pasture Pens (1 & 2)			South Pasture Pens (3 & 4)		
		X Percent of Horizontal Cover			X Percent of Horizontal Cover	
Date of Cover Board Readings	Grazing Treatment	Non-Grazed Pen	Grazed Pen	Grazing Treatment	Non-Grazed Pen	Grazed Pen
7/25 - 8/5	Before	84.25	83.75 N.S.	Before	84.25	82.50 N.S.
8/8 - 8/15	After	82.25	66.50 **	Before	75.50	77.75 N.S.
9/6 - 9/15	After	76.00	64.50 *	After	82.75	71.25 *

N.S. = Non-significant
* = P < .05
** = P < .01

For 1985, deer foraging trials will be repeated as before. It is anticipated that the feeding periods will begin earlier in the season and be spaced at more regular intervals than was used for the past season.

PART 2: DIET COMPOSITION AND HABITAT SELECTION OF TAMED DEER

Deborah K. Selby and Donald A. Klebenow

1984 Objectives:

Analysis of data and completion of M.S. thesis.

1984 Accomplishments:

The thesis has been completed and final oral examinations are scheduled for the graduate student. Thesis copies will be available for distribution during the summer, 1985. A brief portion of the thesis follows:

Plant Species Importance

Shrub species ranked higher in importance over the species of grasses or forbs (Table 5.5). The total percentage of shrubs in the diets of the tame deer in 1982 and 1983 was 75% and 76% respectively. The percent of forbs in the diets was 23% in both years, whereas grasses made up only 2% of the diets in 1982 and 1% in 1983. Of the available shrubs, 58% or 11 of the 19 species were important in one or both years. Only 30 out of 132 available forb species were ranked important. Grasses/grasslikes appeared to have little or no importance. Only *Elymus cinereus* comprised at least 1% in the diets during two 1983 periods.

Shrub species *Eriogonum caespitosum*, *Populus tremuloides*, *Ribes aureum* and *Ribes cereum* were only important in 1982. *Ribes aureum* occurred in three out of five periods in 1982, but in none of the 1983 periods. *Amelanchier utahensis*, *Purshia tridentata*, *Rosa woodsii* and *Symphoricarpos oreophilus* were very important in both years, but increasingly in 1983. All four species contributed to more than 1% of the total diets in all six periods. *Eriogonum umbellatum* rated very significant in 1982, but decreased in importance in 1983. There was no change in importance in *Prunus virginiana* and *Salix spp.* in the two years.

Of the thirty important forbs, twenty-two were important in only one of the two years, the remaining eight were important in both years. *Balsamorhiza sagittata* and *Penstemon watsonii* shifted from no importance in 1982 to very important in 1983. The species consistently important, in both years, were *Geranium viscosissimum*, *Viola nuttallii*, *Mertensia ciliata*, *Wyethia amplexicaulis*, *Paenonia brownii*, *Lomatium dissectum*, *Collomia grandiflora* and *Hackelia micrantha*. *Geranium viscosissimum*, however, dropped its level of importance in 1983. Although thirteen forbs lost importance from 1982 to 1983, ten different forbs gained importance in 1983.

Table 5.5 Importance Rating of Forage Species which Contribute 1% or more of Mule Deer Diets in 1982 and 1983 on the Saval Ranch Research Project.

	Importance[1] 1982	Importance 1983
Shrubs (Total percentage in diet for year)	75%	76%
Amelanchier utahensis	4	6
Eriogonum caespitosum	1	-
Eriogonum umbellatum	5	4
Populus tremuloides	1	-
Prunus virginiana	2	3
Purshia tridentata	5	6
Ribes aureum	3	-
Ribes cereum	1	-
Rosa woodsii	4	6
Salix spp	3	2
Total periods shrub species were important	32	33
Grasses (Total percentage in diet for year)	2%	1%
Elymus cinereus (Total periods important)	-	2
Forbs (Total percentage in diet for year)	23%	23%
Allium bisceptrum	1	-
Arabis glabra	-	1
Aster occidentalis	-	1
Balsamorhiza sagittata	-	4
Castilleja spp	1	-
Castilleja flava	-	2
Collomia grandiflora	2	1
Descurainia pinnata	1	-
Galium spp.	1	-
Geranium viscosissimum	4	2
Hackelia micrantha	1	1
Helianthella uniflora	-	3
Hydrophyllum capitatum	1	-
Lomatium dissectum	2	3
Mertensia ciliata	2	2
Mertensia oblongifolia	-	2
Osmorhiza occidentalis	2	-
Paeonia brownii	1	1
Penstemon watsonii	-	3
Phacelia ramosissima	1	-
Polygonum bistortoides	1	-
Polygonum douglasii	1	-
Potentilla glandulosa	-	2
Potentilla gracilis	3	-
Rumex triangulivalvis	-	1
Smilacina stellata	1	-
Taraxacum officinale	-	2
Thlaspi arvense	1	-
Viola nuttallii	2	2
Wyethia amplexicaulis	1	1
Total periods forb species were important	30	34

[1] Number of periods in which species contributed to 1% or more of the diet.
- Five periods in 1982 and 6 trials in 1983.

Habitat Selection

An indication of habitat preference was obtained by allowing the tame deer to free range in 1982 and 1983. Before cattle grazed, the deer spent the most time in the mountain brush and riparian brush zones (Table 2). The mountain brush type comprised the majority of the deer use area on Stump Creek, and the riparian brush zone only made up 3.1% of the area. The deer spent 35.3% of their time in the riparian brush type at Stump Creek; the low sage, big sage and aspen types, 8.1%, 7.6% and 6.4%, respectively, were the areas the deer occurred n next most frequently. The riparian meadow, low sage plateau and low sage/big sage mosaic types, collectively, contributed only 3.2% of the total deer time. During cattle grazing, increasingly more time was spent in the riparian brush zone, whereas time spent in the mountain brush area decreased slightly. Use in all other types decreased except in the low sage/big sage mosaic, which increased to 5.5% time spent. After the cattle were removed, habitat selection decreased in the riparian brush zone and was offset by an increase in the mountain brush zone. Time spent in all other habitat types made little or no change, except in the low sage/big sage mosaic zone, which reverted back to a no-use status.

The deer utilized five habitat types on Gance Creek (Table 5.6). Before the cattle grazed the Gance Creek area, the mountain brush type contained the most deer use, and the time spent in the riparian meadow and wildrye/tall shrub habitats were about equal. The riparian brush and aspen zones were used 14.9 and 11.8%, respectively. The wildrye/tall shrub habitat, during cattle grazing, increased in utilization and the mountain brush decreased slightly. The riparian areas stayed at about the same utilization level and the utilization in the aspen dropped. When the cattle were removed, the deer spent a greater amount of time in the wildrye/tall brush type and less time in all the other types.

On Stump Creek the deer selected for the riparian brush habitat in all periods, however, the mountain brush, low sage, mosaic and riparian meadow habitats were preferred for in at least one period (Table 5.6). The big sage, low sage plateau, low sage and low sage/big sage mosaic habitats were not utilized in one or more periods. The aspen habitat was avoided throughout both summers, whereas the mountain brush, big sage, low sage plateau, low sage and riparian meadow were avoided in at least one period.

On Gance Creek, the riparian meadow, riparian brush and wildrye/tall shrub habitats were selected for in the before, during and after cattle grazing periods. Additionally, the aspen habitat was selected for in the before cattle grazing period, but not during or after cattle grazing. All other habitats were not preferred.

Table 5.6 Vegetation Type Preference Ratings of Tame Deer in 1982 and 1983 on the Saval Ranch Research Project.

Location and Vegetation Type	Before Grazing Percent Habitat	Before Grazing Percent Use	Before Grazing Pref. Rating[1]	During Grazing Percent Use	During Grazing Pref. Rating	After Grazing Percent Use	After Grazing Pref. Rating
Gance Creek							
Mountain Brush	76.7	31.6	NP	24.6	NP	19.8	NP
Aspen	7.7	11.8	P	2.1	NP	1.7	NP
Riparian Meadow	6	21.6	P	18.1	P	7.9	P
Wildrye/Tall Shrub	6	20.1	P	37.8	P	59.4	P
Riparian Brush	2.7	14.9	P	13.4	P	11.2	P
Stump Creek							
Mountain Brush	47.8	39.4	NP	37.4	NP	50.9	P
Big Sage	17.3	7.6	NP	.3	NU	.2	NU
Low Sage Plateau	10.8	1.7	NP	0	NU	0	NU
Aspen	9.2	6.4	NP	1.6	NP	.8	NP
Low Sage	6.2	8.1	P	1.3	NP	0	NU
Low Sage/Big Sage Mosaic	5.0	0	NU	5.5	P	0	NU
Riparian Brush	3.1	35.3	P	53.4	P	47.0	P
Riparian Meadow	0.6	1.5	P	0.6	NP	1.1	P

[1]Preference ratings derived by the formula:

$$\frac{\text{\% of total deer use}}{\text{\% of available habitat}} - 1 = \text{PR}$$

PR = -1 means no use (NU)
PR = -0.9 to 0 means not preferred (NP)
PR above 0 means preferred (P)

PART 3: THE IMPACTS OF CATTLE GRAZING ON MULE DEER HABITAT USE AND COVER IN NORTHEASTERN NEVADA

Michael Rule and Donald Klebenow

1984 Objectives

To develop a research plan to -

1. Determine the influence cattle grazing may have on mule deer habitat use on the Forest Service summer grazing allotment.

2. Determine the influence cattle grazing may have on the horizontal cover of habitats utilized by mule deer.

1984 Accomplishments

A study plan has been developed, and field research will begin in May, 1985. Study sites will consist of two sets of grazed and ungrazed plots. One set will be located in areas of high fawning and fawn rearing use. The sedond set of plots will be located at the head of two major drainages on the study area. This general area is less important as a fawning area, but receives greater use by bucks and noh-reproductive does throughout the summer and as a fawn rearing area. Care will be taken to select grazed and ungrazed plots within a set that are similar in size, deer densities, habitat types and their availability, distribution of water, and physiographic features. The grazed areas will be located in the South Pasture, which will be grazed July 1 to August 15. The ungrazed areas will be located in the North Pasture where grazing is deferred until August 15. These plots are unfenced and grazing will be controlled on a pasture basis. The plots are bounded to the extent that the area is observable from a fixed observation point. Tentative sites have been selected through field observations during the summer of 1984.

Direct observations of free ranging mule deer and cattle will be made to determine the effect of cattle grazing on deer habitat use. Data will be collected on habitat types utilized, activity, sex and age, group affiliation and location for comparison between grazed and ungrazed areas, both before and during the early grazing period (July 1 to August 15). In addition, comparisons will be made between cattle and deer on the grazed plots.

Measurements of horizontal cover on representative range sites utilized by deer will be made to determine the influence that cattle grazing may have. Comparisons will be made before and after grazing between the grazed and ungrazed plots.

Literature Cited

Nudds, T. D., 1977. Quantifying the vegetative structure of wildlife cover. Wildl. Soc. Bull. 5(3):113-117.

Wallmo, O. C., and D. F. Neff. 1970. Direct observation of tamed deer to measure their consumption of natural forage. Pp. 105-110 in: Range and Wildlife Habitat Evaluation: A Research Symposium. USDA For. Serv. Misc. Pub. 1147.

CHAPTER 6

NONGAME WILDLIFE RESEARCH

J. Kent McAdoo and Donald A. Klebenow

PART 1: EFFECTS OF BRUSH CONTROL AND SEEDING ON RODENTS

1984 Objective:

To complete the fourth and final year of data collection in order to determine the response of rodents to brush control and rangeland seeding.

1984 Accomplishments:

Fieldwork. We sampled rodent populations with two grids of live traps, one each in unaltered sagebrush habitat (Upper Sheep Creek (USC) pasture) and in an area which was plowed to control sagebrush and seeded in 1981 (Lower Sheep Creek (LSC) pasture). Each grid consisted of 100 traps set in a square pattern, with 50 feet between traps. The grids were sampled simultaneously for four consecutive days each in June, July, and August. For comparative purposes, we also conducted a 100 trap grid in an older established seeding (Darling Seeding). Traps were baited with rolled oats and checked twice daily. All rodents captured were ear-tagged, sexed, weighed, and released. We completed vegetation sampling during 1983 (methodology is described in the 1983 Saval Ranch Research and Evaluation Progress Report).

Data Reduction and Analysis. Transfer of four years' data from field forms to computer card format has been completed. We have just started analyzing our tag-recapture data with "Capture," a computer program which handles statistical inference procedures for capture data from closed animal populations (Otis, et al., 1978).

Preliminary Results. Although statistical analysis of the 1984 data is not completed, some implications are obvious from data reduction. Least chipmunks continued to show the most obvious response to the plowing and seeding of the LSC pasture. This species is more abundant in the unaltered sagebrush habitat (USC pasture). Using rodent abundance indices (mean number caught per 400 trap-nights) for comparative purposes, we caught an average of 26 chipmunks per trap period in the sagebrush habitat, compared with less than 2 in the seeding. The 1984 data strongly support our conclusions in the 1983 Progress Report that least chipmunks are adversely affected by brush control. This species has been referred to as a sagebrush obligate (McAdoo and Klebenow, 1979), apparently requiring shrub structure for food, cover, and sentinel perches.

Another obvious difference in rodent populations in the two areas during 1984 was observed for sagebrush voles. This species was uncommon on both grids until 1983, when captures suddenly increased, apparently as the result of a cyclic population phenomenon which paralleled a peak which occurred for mountain voles as well. In 1984, we caught an average of 34 sagebrush voles per trap period in the sagebrush habitat, compared with only 2 in the mixed

species seeding habitat. Like least chipmunks, thriving sagebrush vole populations depend on the presence of adequate sagebrush habitat.

Our data also show, though less obviously, that the seeded area may be more favorable habitat of Ord's kangaroo rats, as indicated by higher catches in the seeding compared to the unaltered sagebrush habitat. Kangaroo rats are known to depend highly on the seeds of forbs and grasses as a food source (McAdoo, et al., 1983). Apparently, the increase in herbaceous cover which resulted from the seeding (1983 Saval Progress Report), and the accompanying seed production were beneficial to kangaroo rats.

Publication Schedule: We plan to have a rough draft manuscript prepared by November 1, 1985, and to submit a manuscript to the Journal of Range Management by March 15, 1986.

PART 2: MOUNTAIN VOLE POPULATION CYCLE

1984 Objective:

To determine relative abundance of mountain voles in an ephemeral drainage habitat.

1984 Accomplishments:

Fieldwork. We continued to sample mountain voles with a grid of 100 live traps placed in an ephemeral creek bottom habitat (Sheep Creek) in the LSC pasture. The traps were placed 50 feet apart, baited with rolled oats, and checked twice daily (morning and evening) for four consecutive days during sampling periods in June and July. An attempt was also made to trap in May (as in each of the three previous years), but flooding of the grid by higher than normal spring runoff thwarted this effort. All animals captured were ear-tagged, sexed, weighed, and released. We also completed vegetation sampling on the grid, using methods described in the 1983 Saval Ranch Research and Evaluation Progress Report.

Data Reduction and Analysis. Transfer of four years' data from field forms to computer card format is approximately 80% completed. We plan to analyze tag-recapture data with "Capture," a computer program which handles statistical inference procedures for capture data from closed animal populations (Otis, et al., 1978).

Preliminary Results. Vole abundance along the ephemeral Sheep Creek drainage decreased by approximately 50% from summer 1983 to summer 1984. However, the 1984 population is approximately 20 times higher than the 1981 population. The exponential increase during 1983 (see the 1983 Progress Report) was due to a cyclical population peak. Although cyclic fluctuations of voles have been reported in the literature (Elton, 1942; Krebs, 1966), little is known about vole population cycling in the Great Basin.

During both 1983 and 1984, mountain voles dispersed into the adjacent mixed species seeding habitat where no voles were trapped during 1982. When the

population was peaking, we also noticed a concentration of long-eared owls hunting in the vicinity of the Sheep Creek drainage and the adjacent seeding. During the winter of 1983-84, girdling of shrubs (especially big sagebrush and bitterbrush) occurred along many drainages in the study area. Such activity has been previously attributed to peak vole populations by other researchers (Mueggler, 1967; Frischnecht and Baker, 1972).

Publication Schedule: For better description of the population cycle, we plan to collect data during the summer of 1985 (with the expectation that mountain vole numbers will approach a cyclic low). We plan to have a rough draft manuscript completed by October 15, 1985, and to submit a manuscript to the Journal of Mammalogy by December 31, 1985.

PART 3: HABITAT AFFINITIES OF MERRIAM'S SHREW

1984 Objective:

To collect Merriam's shrews and describe habitats in which they occur, incidental to primary project objectives.

1984 Accomplishments:

Fieldwork. We continued to record specimens of Merriam's shrews collected incidentally (in the course of other small mammal research) and to describe Merriam's shrew habitat. The shrews were collected in pitfall cans and Sherman live-traps.

Data Reduction and Analysis. During the summers of 1981 through 1984, we captured 27 Merriam's shrews in shrub dominated habitats of both valley floors and mountain ranges. This work was purely dexcriptive, and thus no statistical tests were made.

Results. Prior to our work, only one Merriam's shrew had been collected in northeastern Nevada. Even for the Great Basin region in general, little information on shrews is available. In basin areas (valley floors) we caught shrews in habitats with moderate shrub cover of big sagebrush, rubber rabbitbrush, and antelope bitterbrush. Typical understory consisted of sparse forbs, bunchgrasses, and usually extensive bare ground. In these areas, shrews were caught 10 to 200 m. away from creek beds in relatively dry soils.

We also caught Merriam's shrews at higher elevations on south-facing mountain slopes. The dense shrub cover here consisted of big sagebrush, antelope bitterbrush, squaw currant, and mountain snowberry with almost no understory.

These habitats were situated on dry, well-drained soils several hundred yards from the nearest drainage.

Our records indicate that Merriam's shrew, although inconspicuous, is a fairly common member of small mammal communities in sagebrush basins and in mountain brush habitats of northeastern Nevada.

Publication Schedule: A manuscript was submitted to the Journal of Mammalogy in January 1985. The editor responded with a recommendation that our manuscript be published in a regional journal. We will, therefore, submit a revised manuscript to the Great Basin Naturalist in May 1985.

PART 4: MICROHABITAT CHARACTERISTICS AND OVERLAP OF THREE SYMPATRIC SHREW SPECIES

1984 Objective:

To determine microhabitat characteristics of three sympatric shrew species.

1984 Accomplishments:

Fieldwork. Previous nongame inventory work revealed the presence of several shrew species in the Saval study area (1982 Saval Ranch Research and Evaluation Progress Report), and further sampling showed sympatric occurrence of species along ephemeral drainages. During the 1984 field season, we collected shrews along one such drainage (Sheep Creek) in the USC pasture.

We placed 70 one-gallon pitfall cans along the drainage in a 7 X 10 grid pattern, with 15 m. (46 feet) spacing between cans (trap-stations). The cans were buried to ground level, then covered with wooden lids propped up 2-3 inches above can mouths. Shrew specimens were collected weekly from June 20 to October 30, 1984, for a total of 7,140 trap-nights. Although most specimens were dead and dehydrated when collected, skull preservation enabled species identification in the lab with a dissecting scope and taxonomic key.

In July quantitative vegetation data were collected for each trap station on the grid. A nested frequency method was used to measure percent frequency by species. We also used the frequency frame as a reference to estimate canopy cover for shrubs, herbaceous vegetation, and total vegetation.

In addition, soil moisture was measured by taking soil samples at each station. Dry soil weights (obtained by oven-drying samples at 105° C. for 24 hours) were subtracted from wet weights to determine soil moisture content at each station.

Data Reduction and Analysis. We collected a total of 66 shrew specimens on the pitfall grid: 34 specimens of vagrant shrews, 21 montane shrews, and 11 Merriam's shrews. The distribution of captures on the grid showed some overlap between vagrant shrews and montane shrews. These two species had seven trap stations in common where both were collected, but the two were never caught together in the same week. Vagrant shrews and Merriam's shrews had only one trap station in common, but not during the same week. Montane shrews and Merriam's shrews were never caught at the same stations.

We used analysis of variance and Duncan's new multiple range test to make quantitative comparisons of vegetation characteristics among stations at which each of the three shrew species were caught. Differences in percent shrub cover, percent herbaceous cover, and percent total cover were tested among the

three species. A plant community similarity index (Wolda, 1981) was used to show similarities in plant community preference by each possible pair of shrew species.

Preliminary Results: Percent total canopy cover was significantly (P 0.05) different among the sites where the three species were collected. Montane shrews were found in areas of highest total cover, while Merriam's shrews were found in sites with least total cover. Montane and vagrant shrews frequented areas with similar percent herbaceous cover, but Merriam's shrews were found where herbaceous cover was significantly less (P 0.05).

Montane shrews were found in areas with significantly higher percent shrub cover, while the other two species occupied areas similar in shrub cover component (P 0.05).

The percent similarity (PS) index showed the extent of qualitative similarities in plant communities used by each possible pairing of shrew species. According to this index, montane shrews and vagrant shrews used very similar habitats (PS = 99.2), while montane shrews and Merriam's shrews were much more dissimilar in habitat use (PS = 46.5), as were vagrant shrews and Merriam's shrews (PS = 45.8).

Our data imply some microhabitat partitioning among three sympatric shrew species, the most obvious being the Montane shrew's preference for areas of high percent canopy cover. However, the repeated captures of Montane shrews and vagrant shrews at the same pitfall stations, and the qualitative plant community similarity of areas they frequent, suggest that microhabitat preference does not act as the sole isolating mechanism for these two species on Sheep Creek. The vagrant shrew can be described as a broad spectrum species overlapping in some vegetational components with the other two species, thus accounting for its wide distribution on the grid. Merriam's shrews were found in areas with sparse vegetation canopy cover, fewer plant species, more xeric soils, and typically captured 10-30 yards from the creek. For this species, these microhabitat components may act as isolating mechanisms, reducing competition with vagrant shrews and montane shrews.

Publication Schedule: Data analysis and a first draft of manuscript have been completed. Writing of second draft is in progress. We plan to submit this manuscript to the Journal of Mammalogy by July 1985

PART 5: BLACK-TAILED JACKRABBIT USE OF NEW RANGELAND SEEDINGS

1984 Objective:

To complete data analysis and write manuscript.

Accomplishments:

Fieldwork. No fieldwork was undertaken in 1984. Date were collected in 1982 from the Saval Ranch and the 71 Ranch in northern Nevada, and the Gund Ranch area in central Nevada. Seeding sizes were 450 ha, 400 ha, and 50 ha,

respectively. The primary objectives of this study were to determine: (1) the extent of jackrabbit use of rangeland seedings during their first growing seasons, and (2) whether jackrabbit use varies with seeding size (as measured by midpoint distance), time, distance into seeding, and jackrabbit abundance. Monthly counts of jackrabbit pellets on $1m^2$ circular plots were used as an index of jackrabbit grazing pressure (use). At the 71 Ranch we established these plots at 100m. intervals from the edge of the seeding out to 400m. into the seeding (seeding midpoint). Twenty-four plots were set up along a 300m. transect at each interval. Plots at the Gund Ranch seeding were established similarly, but only out to a distance of 200m. (seeding midpoint). At the Saval Ranch seeding we used the same scheme, but with only two transects of 24 plots each: one along the seeding edge and a second at the seeding midpoint (400m.). Jackrabbit pellets were removed at the beginning of the study for each area, then counted and removed at monthly intervals. Counts were made for June, July, August, and September at the 71 Ranch seeding in 1982, and for the same months at the Gund Ranch seeding in 1983. Pellets were counted at the Saval Ranch seeding only for September, 1982.

Pellet counts from transects in sagebrush habitat at the 71 Ranch and Gund Ranch were used as indices of jackrabbit abundance for these area. These transects were set up as described above for the seeding transects, and were located approximately 1 km away from the seedings. Since no control plots were established at the Saval Ranch, we used pellet counts at the seeding edge for a jackrabbit abundance index. Since jackrabbit densities may be higher near seedings than in native range (Fagerstone et al. 1980), counts at the seeding edge could conceivably be an overestimate of jackrabbit abundance. However, jackrabbit abundance was extremely low in 1982 following a population crash, so that these pellet counts seemed representative of the low rabbit abundance as determined by strip-census transects (McAdoo, unpublished data).

Data reduction and analysis. A Hartley's F-max test, used to check for homogeneity of variance, showed wide fluctuations in variances for the pellet count data. Since variability increased directly with increasing means, we used a square-root transformation to stabilize variances, then performed analysis of variance and Duncan's multiple range test on the transformed data. We also used analysis of variance on raw data and found that results were similar to those obtained with the square root transformation.

To determine whether there was a relationship between jackrabbit use of seedings and various seeding characteristics, we used pellets/m^2 as the dependent variable in a multiple regression equation. This indicator of jackrabbit use was regressed against the variables for which measurements were available at each seeding. The time (month of sampling) variable was quantified by expressing time as the number of days since seeding establishment. A step-wise regression procedure was used to determine relative importance of the variables.

Preliminary Results. Multiple regression analysis from data pooled across all three seedings resulted in the following equation:

$$u = 100.54 - 0.762M + 0.701T - 0.105D + 4.913A + E$$

$$(F_{4,132} = 87.96,\ P = 0.01,\ R^2 = 0.729),$$

where u is jackrabbit use (measured by pellets/m^2), M is midpoint of seeding, T is time since seeding establishment, D is distance of use from seeding edge, A is jackrabbit abundance, and E is an error term. This equation suggests that 73% of the variability in jackrabbit use of seedings was accounted for by these variables. Stepwise multiple regression procedure revealed seeding midpoint as the factor having greatest influence on jackrabbit use ($R^2 = 0.62$). Midpoint distance was inversely correlated with extent of jackrabbit use, indicating that larger seedings receive less grazing pressure from jackrabbits. D also entered into the equation negatively, indicating that jackrabbit use varied inversely with distance into the seeding. Variables T and M together produced the best 2-independent variable equation ($R^2 = 0.68$). The best 3-independent-variable equation was obtained using M, T, and D ($R^2 = 0.71$). Jackrabbit abundance (as measured by pellet counts at edge of seeding) was the least important variable as indicated by the stepwise procedure.

Seedling crested wheatgrass in new seedings may provide quality jackrabbit forage, since plants in early developmental stages have peak nutritive value (Flinders and Hansen, 1972). The inverse relationship of jackrabbit use to midpoint distance was not surprising. Jackrabbits seem to prefer feeding sites that enable them to detect danger from moderate distances but which do not render them conspicuous from great distances (Hansen and Flinders, 1969). Use of the large Saval Ranch seeding by jackrabbits was low both at the seeding edge and at the midpoint, apparently a function of the low jackrabbit population in the area as compared to the 71 Ranch and Gund Ranch areas.

A companion study showed that even on small seedings where jackrabbit utilization of seedlings is uniformly high from edge to midpoint, seedling establishment and survival may not be affected by jackrabbit grazing unless drought and restricted root zone were accompanying factors (Roundy et al. 1985).

Publication Schedule:

A first draft manuscript has been written and reviews from co-authors have been received. Writing of second draft is in progress. We plan to submit this manuscript to the Journal of Range Management by August, 1985.

PART 6: HABITAT CORRELATES OF RIPARIAN BIRDS AS RELATED TO CATTLE GRAZING

1984 Objectives:

(1) To determine relative abundance and species composition of bird populations along three riparian zones in the South National Forest (SNF) Pasture, and (2) to determine how various bird species are related to habitat components.

1984 Accomplishments:

Fieldwork. We conducted bird-count transects in each of three drainages: Gance Creek, Jim Creek, and Mahala Creek. Transects were repeated three times for the Gance and Mahala Creek drainage, and twice for Jim Creek (sampling of the Stump Creek drainage was abandoned in order to increase sampling intensity in the other three drainages). We made the bird counts between mid-June and early July, during the peak of breeding activity at these higher elevations. During each sampling period, bird transects were conducted beginning at sunrise for three consecutive days (weather permitting). The counts consisted of 5-minute stops at 10 variable circular plots 350 yards apart, during which all territorial males seen and heard were recorded.

Vegetation sampling methods were described in the 1983 Saval Ranch Research and Evaluation Progress Report.

Data reduction and analysis. For purposes of this report, bird abundance values have been reported as mean number of birds observed per transect-day. We plan to determine bird density (by species) with a method similar to that described by Szaro and Balda (1982). We will then use each bird density as the dependent variable in a multiple regression equation, with habitat measurements (including canopy cover and height for each vegetation layer) as independent variables.

Preliminary results. Although statistical analysis has not been completed, results of the riparian bird data collected during 1984 appear to follow the same pattern as those discussed in last year's progress report. Yellow warblers continue to be in approximately equal abundance in each of the three drainages. However, fox sparrows and song sparrows continue to be more abundant in the Gance Creek drainage. For example, during the late June sampling period, we counted an average of 18.0 fox sparrows per transect-day along the Gance Creek transect, compared to 7.7 along Mahala Creek, and 6.0 along Jim Creek. Although all three species are commonly associated with willow cover, fox sparrows and song sparrows seem more dependent on the large, continuous closed canopy stands of willow such as found along the Gance Creek transect.

Also as reported last year, a guild of species associated with the shrub substrate continues to be more abundant where riparian shrub cover (including big sagebrush, currant, snowberry, and rose) is highest. Specifically, white-crowned sparrows, green-tailed towhees, rufous-sided towhees, and Brewer's sparrows were more common along Mahala Creek and Jim Creek where shrub canopy cover is higher. This relationship was particularly obvious for green-tailed towhees. We counted an average of 19.3 and 20.3 per transect-day along Mahala Creek and Jim Creek, respectively, compared with only 6.3 along Gance Creek. Vegetation sampling is not complete for Jim Creek, but shrub cover along the Mahala Creek transect is significantly higher ($P < .01$) than that along Gance Creek.

Mourning doves continued to be more abundant along Mahala Creek (as reported last year). The reasons for the higher numbers in this drainage than along Gance Creek and Jim Creek are still unclear. We have noticed an abundance of weedy forbs in the Mahala Creek drainage which may be providing an attractive

food source (seeds) for doves. It is unlikely that the higher abundance along Mahala Creek is related to nesting substrate, because doves are known to nest both in trees and shrubs (Harrison, 1979).

Not much information is available on riparian bird communities in the Great Basin. We hope to learn how and why some riparian species are related to various habitat components. With this background information we might then be able to predict bird population responses that may occur as the result of vegetation changes brought about by livestock grazing practices.

Publication Schedule: During the 1985 field season, vegetation sampling will be completed. The three years of bird count data (1982-1984) will then be analyzed to determine habitat correlations. We plan to have a first-draft manuscript completed by December, 1985.

PART 7: RESPONSES OF NONGAME BIRDS TO MIXED SPECIES RANGELAND SEEDING

1984 Objectives:

(1) To complete the fourth and final year of data collection designed to determine response of nongame birds to mixed species rangeland seeding, and (2) to analyze four years (1981-1984) of data in preparation for publishing manuscript.

1984 Accomplishments:

Fieldwork. We conducted two transects each in the LSC seeding and USC native sagebrush (control) habitat. During each sampling period, bird counts were conducted at sunrise for three consecutive days (weather permitting). The counts consisted of 5-minute stops at 8 variable circular plots 9.3m apart, during which all territorial males seen and heard were recorded. We made the bird counts in early June at the peak of breeding activity for this elevation.

Vegetation sampling was completed during the summers of 1982 and 1983. Methods were described in the 1983 Saval Ranch Research and Evaluation Progress Report.

Data reduction and analysis. We used regression analysis to make comparisons between the seeding and unaltered sagebrush habitat each year, as well as comparison among years within the seeding and among years within the sagebrush habitat. Predicted values of bird abundance (y) along with confidence intervals (for each species) were used to detect significant differences in bird abundance which resulted from vegetation changes brought about by the seeding. However, we are currently in the process of re-analyzing the bird abundance data using paired T-tests for a more powerful statistical comparison.

Differences in vegetation between the seeded area and the untreated sagebrush were determined by using Student's T-test to compare vegetation parameters measured in each area (shrub cover, herbaceous cover, total cover, shrub height, and shrub density).

Preliminary results. Some obvious changes in bird abundance were brought about by plowing and seeding in the LSC area. The most discernible response was an increase in ground/grass nesting species. The horned lark, a ground nesting species, responded favorably to establishment of the seeding, increasing significantly ($P < 0.05$). Horned larks nest on the gound in open areas and are reportedly most common in disturbed grasslands (Kendeigh, 1941).

The grass nesting western meadowlark also responded positively to establishment of the LSC seeding. Meadowlarks increased significantly (P 0.05), almost seven-fold, from 1981 to 1984. However, meadowlarks had a delayed response to the seeding, probably related to the gradual increase in herbaceous cover as the seeded species became established. By 1983, herbaceous cover in the seeded species was significantly higher ($P < 0.01$), at 10.5%, than that in the untreated sagebrush (5.2%). Castrale (1982) reported that meadowlarks tend to be more abundant where perennial grass cover is greater.

Shrub cover was significantly lower ($P < 0.01$) after shrub reduction by plowing in the seeded area (4.8% shrub cover in the seeding, compared to 22.1% in the untreated sagebrush). However, we did not detect proportionate decreases in abundance of the common shrub nesting species, such as Brewer's sparrows and sage thrashers. Although the dependence of these species on shrub structure for nesting is well-known (McAdoo and Klebenow, 1979), perhaps dense shrub cover is not required to support moderate populations. There is also the possibility that the edge effect of adjacent sagebrush cover biased our results somewhat, though we made an effort to excluse birds detected along the edge from our counts. We have tentatively concluded that shrub reduction on the seeded area was only slightly detrimental to Brewer's sparrows and sage thrashers.

Publication Schedule: We plan to have a first draft manuscript completed by September, 1985, and to submit a manuscript to the Journal of Range Management by December, 1985.

Literature Cited

Castrale, J. S. 1982. Effects of two sagebrush control methods on nongame birds. J. Wildl. Manage. 46:945-952.

Elton, C. 1942. Voles, mice, and lemmings: Problems in population dynamics. Oxford: Clarendon Press. 496 p.

Fagerstone, K. A., G. K. Lavoie, and R. E. Griffith, Jr. 1980. Black-tailed jackrabbit diet and density on rangeland and near agricultural crops. J. Range Manage. 33:229-233.

Flinders, J. T., and R. M. Hansen. 1972. Diets and habitats of jackrabbits in northeastern Colorado. Colo. State Univ. Range Sci. Dep. Sci. Ser. No. 12, 29 p.

Frischnecht, N. C., and M. F. Baker. 1972. Voles can improve sagebrush rangelands. J. Range Manage. 25:466-468.

Hansen, R. M., and J. T. Flinders. 1969. Food habits of North American hares. Colo. State Univ. Range Sci. Dep. Sci. Ser. No. 1. 18 p.

Harrison, H. H. 1979. A field guide to western bird's nests in the United States west of the Mississippi River. Houghton Mifflin Co., Boston, Mass. 279 p.

Kendeigh, S. C. 1941. Birds of a prairie community. Condor 43:165-174.

Krebs, C. J. 1966. Demographic changes in fluctuating populations of *Microtus californicus*. Ecol. Monogr.

McAdoo, J. K., and D. A. Klebenow. 1979. Native faunal relationships in sagebrush ecosystems. p. 50-61. *In*: The Sagebrush Ecosystem: A Symposium. Utah State Univ., Logan, UT 251 p.

McAdoo, J. K., C. C. Evans, B. A. Roundy, J. A. Young, and R. A. Evans. 1983. Influence of heteromyid rodents on *Oryzopsis hymenoides* germination. J. Range Manage. 36:61-64.

Mueggler, W. F. 1967. Voles damage big sagebrush in southwestern Montana. J. Range Manage. 20:88-90.

Otis, D. L., K. P. Burnham, G. C. White, and D. R. Anderson. 1978. Statistical inference from capture data on closed animal populations. Wildl. Monogr. No. 162. 135 p.

Roundy, B. A., G. J. Cluff, J. K. McAdoo, and R. A. Evans. 1985. Effects of jackrabbit grazing, clipping, and drought on crested wheatgrass seedlings. J. Range Manage. In press.

Szaho, R. C., and R. P. Balda. 1982. Selection and monitoring of avian indicator species: an example from a ponderosa pine forest in the Southwest. USDA For. Serv. Gen. Tech. Rep. RM-89, Rocky Mtn. Forest and Range Exp. Sta., Fort Collins, Colo. 8 p.

CHAPTER 7

FISHERIES RESEARCH

William S. Platts
Richard J. Torquemada

The study goals for the 1984 fiscal year embodied continuation of the time trend analysis of fishery and riparian habitat conditions on Gance Creek. This is in agreement with the overall objectives of the fisheries phase of the Saval Ranch Project and the Livestock-Fishery Interaction studies, which include the following:

1. Determine the rehabilitative potential of Gance Creek based on past, present, and future livestock grazing strategies;

2. Evaluate the usefulness of excluding livestock from the Gance Creek riparian zone by studying protected habitat within a fenced exclosure;

3. Evaluate the compatibility of the existing deferred grazing system with the fisheries habitat of Gance Creek; and

4. Make recommendations as to the optimum grazing strategies relative to use and protection of the riparian zone.

1984 Objectives

1. Collection of geomorphic/aquatic, riparian, streamside herbage (not reported here), and fish population as in previous years;

2. Comparison of these FY 1984 data with that of previous years;

3. Discussion of any habitat condition trends that may be becoming apparent as the data base increases;

4. Discussion of any extraneous factors that may be influencing the fishery system;

5. Monitor stream temperature in cooperation with BLM personnel.

1984 Accomplishments

New Variables/Changes in Methodology[1/]

Two new geomorphic/aquatic variables were added in 1984; channel bottom width and top bank to top bank. Channel bottom width measured the area

---

[1/] A more thorough description of study design and methods is presented in Platts and Nelson, 1983.

of channel bottom under a transect line regardless of stream width. Top bank to top bank measured that distance between the two highest points of each bank, also along a transect line. Fisheries environment rating, light intensity, and canopy cover were not collected in 1984.

A new method of measuring incoming solar radiation was used on Gance Creek in 1984. This involved the use of a Solar Pathfinder™, which measures the percent of unobstructed sun hitting the middle of the stream on a year round basis. This information can then be used to calculate BTU's/FT^2/day or month for a particular area.

Hydrologic data and channel profiles were also collected in 1984.

Water Column

Because of another record snowfall and runoff year in 1984, many water column variables continued the trends noted in 1983 (Table 7.1). Stream width again increased in all three sites, while depths remained comparable to 1983 levels (Table 7.2). This increase possibly contributed to the change in the pool/riffle composition. Riffle area increased in all sites, making up a larger portion of the water column than pools. This is the first year since 1981 that riffles have dominated. Pool feature remained stable, however pool rating decreased in all three areas. Since pool rating is an index based on the diameter, depth, and the amount of cover, the decreased pool area along with stable depths and instream vegetation would account for the lower pool rating.

The canopy cover measurement was eliminated in 1984 and replaced with the new Solar Pathfinder™ analysis. This analysis measures BTU's of energy reaching the mid-point of the channel (Table 7.3). Results from this analysis confirm those obtained using the canopy cover and light intensity variables in 1983: site 2 receives the least amount of solar energy, followed by sites 1 and 3. The combination of higher banks and dense vegetation found in site 2 provide a more shaded streamside environment (Figure 7.1).

Streambanks

Many factors such as changes in streamflow, channel elevation, and observer bias have affected bank angle measurements over the last 7 years. Trends since 1981, however, show a gradual improvement in the ungrazed exclosure site 2; a slight improvement in grazed site 3; and an overall slight increase in grazed site 1. These trends in smaller, and more beneficial, bank angles are also mirrored by improvements in more bank undercut. The exclosure had significantly larger undercuts than the two grazed sites, however, site 3 also has shown continued increases since 1981 (Figure 7.2). The annual trend toward wider stream widths is eroding banks; thus, reducing bank angles while still keeping bank water depth stable.

Table 7.1.--Summary of geomorphic/aquatic results for 1984, Gance Creek, Nevada.

Variable	Site 1 (control)			Site 2 (treatment)			Site 3 (control)		
	Mean	S.D.[1/]	C.I.[1/]	Mean	S.D.	C.I.	Mean	S.D.	C.I.
Geomorphic/aquatic									
Water Column									
Stream width (feet)	7.5	2.4	6.9-14.3	7.6	2.2	7.0-8.1	7.3	1.9	6.8 - 7.7
Stream depth (feet)	0.30	0.15	0.26-0.34	0.30	0.11	0.21-0.38	0.28	0.14	0.24-0.32
Riffle width (percent)	54.7	30.5	46.9-62.5	61.4	30.1	53.6-69.1	57.5	31.1	49.4-65.5
Pool width (percent)	45.3	30.5	37.5-53.1	38.6	30.1	30.9-46.4	42.5	31.1	34.5-50.6
Pool rating	2.4	1.3	2.0-2.7	2.2	1.2	1.9-2.6	2.1	1.3	2.1-2.2
Pool feature	5.1	0.4	4.7-5.4	4.9	0.8	4.6-5.1	4.9	0.9	4.7-5.2
Streambanks									
Bank angle (degrees)*	116.	34.7	107.5-125.3	98.	36.4	88.4-107.2	114.	35.4	104.9-123.2
Bank undercut (feet)*	0.23	0.32	0.15-0.32	0.45	0.44	0.33-0.56	0.29	0.43	0.18-0.40
Bank depth (feet)	0.13	0.17	0.08-0.17	0.15	0.15	0.11-0.18	0.11	0.15	0.25-0.33
Channel bottom width (feet)	10.0	4.5	8.8-11.1	9.5	2.9	8.7-10.2	9.3	2.9	8.5-10.0
Top bank to top bank (feet)	17.9	6.9	16.2-19.7	16.5	3.9	15.5-17.5	16.5	6.7	14.7-18.2
Topchan	1.9	0.6	1.8-2.1	1.9	0.7	1.7-2.1	1.8	0.6	1.7-2.0
Streambottom									
Fines <0.03 in. (percent)**	13.9	18.4	1.1-5.2	5.5	11.1	2.7-8.4	8.0	12.6	4.8-11.3
Fines >0.03 in. (percent)	3.2	8.2	9.2-18.6	4.2	9.2	1.8-6.6	6.1	13.8	2.6-9.7
Gravel (percent)*	60.7	24.0	54.6-66.9	51.2	28.3	43.9-58.6	60.7	26.6	53.8-67.5
Rubble (percent)*	20.0	19.8	14.9-25.1	26.4	20.1	21.3-31.6	19.1	21.8	13.4-24.7
Boulder (percent)*	2.3	5.7	0.8-3.7	12.9	15.6	9.9-18.0	6.1	13.3	2.7-9.5
Substrate embeddedness	2.6	0.7	2.4-2.8	2.6	0.7	2.4-2.8	2.4	0.8	0.2-0.3
Instream vegetal cover (feet)*	0.5	1.0	0.3-0.8	0.2	0.4	0.10-0.3	0.5	1.2	0.2-0.8
Riparian									
Bank cover stability	2.3	1.0	2.0-2.5	2.2	0.8	1.9-2.4	2.2	1.0	1.9-2.5
Stream cover	2.3	1.0	2.1-2.6	2.4	0.9	2.1-2.6	2.2	1.1	1.9-2.5
Vegetation overhang (feet)	0.06	0.22	0.01-0.12	0.07	0.15	0.03-0.10	0.05	0.15	0.01-0.09
Vegetation use (percent)	10.8	14.4	7.1-14.5	0	-	-	1.9	4.2	0.8-3.0
Bank alteration (percent)									
natural***	36.8	13.3	33.4-40.2	38.8	13.5	35.3-42.3	41.6	13.8	38.0-45.2
artificial*	8.7	8.7	6.5-11.0	1.8	2.9	1.0-2.5	7.6	7.9	5.6-9.7
total	45.5			40.6			48.2		

1/ S.D.: Standard Deviation; C.I.: 95 percent Confidence Interval.
* Significant difference between controls and treatment at P = .05.
** Significant difference between controls vs. controls and controls vs. treatment at P = .05.
***Significant difference between controls at P = .05.

Table 7.2.--Summary of Geomorphic/aquatic means, Gance Creek, Nevada 1978-1984.

	WATER COLUMN							STREAMBANKS				STREAM BOTTOM						
	Stream width (feet)	Stream depth (feet)	Riffle width (%)	Pool width (%)	Pool feat.[3/]	Pool rating	Canopy Cover (deg.)	Bank Angle (deg.)	Bank under-cut (feet)	Bank depth (feet)	Fish. rating	Fines <0.03 inches (%)	Fines >0.03 inches (%)	Gravel (%)	Rubble (%)	Boulder (%)	Embed-dedness	Instream cover (feet)
Site 1[1/]																		
1978	5.1	0.19	69.4	30.6	1.2	1.9	ND[4/]	126	0.06	0.05	1.1	10.5	8.1	76.5	3.6	1.3	3.1	0.3
1979	5.2	0.22	73.7	26.3	1.0	1.6	ND	107	0.20	0.10	1.4	11.4	4.8	67.5	13.1	3.2	3.5	0.3
1980	6.0	0.24	43.1	56.9	1.0	2.5	ND	114	0.17	0.12	1.8	15.9	1.7	70.7	9.4	2.3	2.1	0.2
1981	5.9	0.22	60.6	38.8	4.2	1.9	56	111	0.22	0.08	1.6	10.6	2.8	74.0	10.8	1.7	3.4	0.0
1982	6.3	0.29	26.4	73.6	3.8	3.0	40	117	0.19	0.10	2.1	6.2	5.8	72.5	13.4	2.1	2.4	0.6
1983	6.5	0.30	36.8	63.2	5.0	2.8	48	120	0.21	0.14	2.3	6.9	4.2	67.4	20.9	1.7	2.9	0.4
1984	7.5	0.30	54.7	45.3	5.1	2.4	ND	116	0.23	0.13	ND	13.9	3.2	60.7	20.0	2.3	2.6	0.5
Site 2[2/]																		
1978	6.0	0.22	78.4	21.6	1.0	1.9	ND	123	0.09	0.04	1.1	8.6	1.7	80.3	8.3	1.1	3.6	0.1
1979	5.6	0.22	78.6	21.4	1.0	1.8	ND	95	0.33	0.07	1.6	4.5	2.5	63.6	22.5	7.3	4.0	0.3
1980	6.5	0.25	48.3	51.7	1.0	2.5	ND	121	0.18	0.10	1.7	9.3	2.2	66.6	14.3	7.7	2.7	0.3
1981	6.1	0.22	77.8	22.0	3.4	1.3	48	127	0.16	0.05	1.6	5.6	1.0	72.0	14.1	7.3	4.1	0.0
1982	5.9	0.23	41.9	58.1	4.6	2.3	26	118	0.23	0.07	1.7	2.2	3.7	67.4	18.2	8.5	3.1	0.2
1983	6.4	0.29	38.8	61.2	5.0	2.7	24	108	0.28	0.13	2.5	3.9	3.0	56.9	26.2	11.0	2.7	0.3
1984	7.6	0.30	61.4	38.6	4.9	2.2	ND	98	0.45	0.15	ND	5.5	4.2	51.2	26.4	12.9	2.6	0.2
Site 3[1/]																		
1978	4.5	0.15	70.6	29.4	1.0	1.6	ND	141	0.08	0.03	1.5	1.2	7.9	86.2	3.0	1.7	3.8	0.3
1979	5.5	0.19	75.3	24.7	1.0	1.8	ND	114	0.14	0.04	1.4	4.7	6.5	78.3	6.3	4.3	4.2	0.6
1980	6.4	0.21	53.1	46.9	1.0	2.2	ND	126	0.14	0.10	1.7	14.8	3.7	74.8	3.1	3.6	3.1	0.3
1981	6.2	0.21	74.1	25.9	3.5	1.5	55	135	0.10	0.05	1.5	9.6	5.8	80.5	1.8	2.1	3.9	0.0
1982	5.6	0.21	36.2	63.8	4.3	2.8	38	122	0.13	0.06	1.8	7.1	8.6	79.0	1.7	3.6	2.7	0.4
1983	6.7	0.27	43.5	56.5	4.9	2.6	33	119	0.22	0.10	2.1	7.2	4.7	68.6	13.7	5.8	2.9	0.5
1984	7.3	0.29	57.5	42.5	4.9	2.1	ND	114	0.29	0.11	ND	8.0	6.1	60.7	19.1	6.1	2.4	0.5

[1/]Control

[2/]Treatment

[3/]The evaluation scale for this parameter was modified to include more ratings in 1981.

[4/]ND = No data

Table 7.3.--Average monthly solar input (BTU's/Ft^2) to the Gance Creek study area. (N = 12)

Month	Site 1 (control)	Site 2 (treatment)	Site 3 (control)
January	197.0	120.5	101.1
February	342.1	201.7	239.5
March	537.3	366.7	471.6
April	781.7	728.2	766.0
May	1,041.7	1,012.9	1,074.3
June	1,234.3	1,238.6	1,272.3
July	1,214.8	1,230.0	1,260.7
August	1,018.3	914.0	991.3
September	824.6	613.3	616.5
October	446.5	264.4	322.8
November	263.3	161.1	127.9
December	131.8	89.3	92.9
Year Total	8,033.4	6,940.7	7,337.0

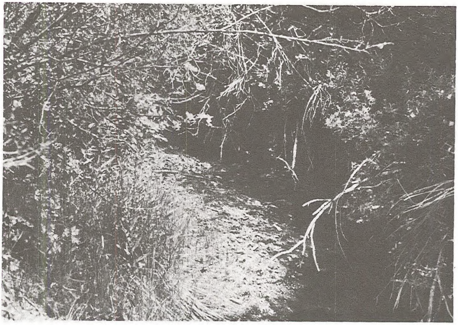


Figure 7.1. Dense vegetation in site 2 limits solar input.

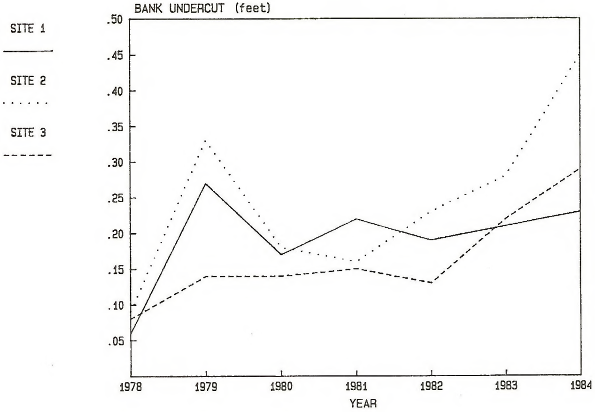


Figure 7.2. Bank undercut trends for controls (sites 1 and 3) and treatment area (site 2) Gance Creek, Nevada.

Stream Bottom

Back-to-back high runoff years (1983 and 1984) have also affected stream bottom conditions. The decline in gravel, the most common substrate, continued at a greater rate in 1984. This decline was accompanied by a corresponding increase in fine sediment, along with increases in rubble and boulder (Figure 7.3). The increase in fine sediment is also reflected in a lower embeddedness rating, which translates to a higher amount of fine material surrounding gravel, rubble, and boulder. Increased fines and embeddedness have been shown to inhibit fish reproduction success and fish food production. The amount of instream vegetation has remained stable, increasing only slightly in site 2 in 1984.

The largest increase in fine sediment occurred in site 1 (135 percent). Mining activity adjacent to the sight may possibly be contributing to the increase in fines in this reach.

Riparian Conditions

The amount of channel movement is also reflected in our riparian condition measurements. In 1984, streambank alteration attributable to natural causes reached the highest levels of the 7-year-period (Figure 7.4). These high levels effectively masked out alteration that may have

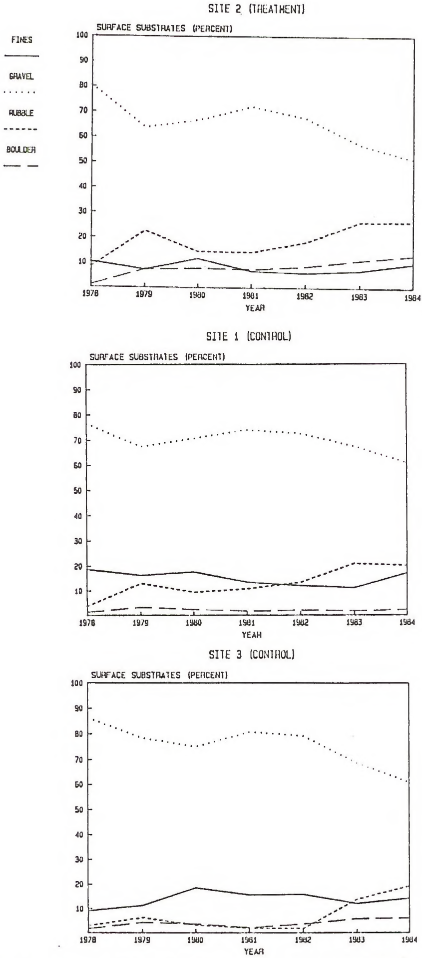


Figure 7.3. Surface substrate trends, Gance Creek, Nevada.

been caused by grazing during 1984. Streamside cover, bank stability, and overhanging vegetation showed little difference between sites (Table 7.3).

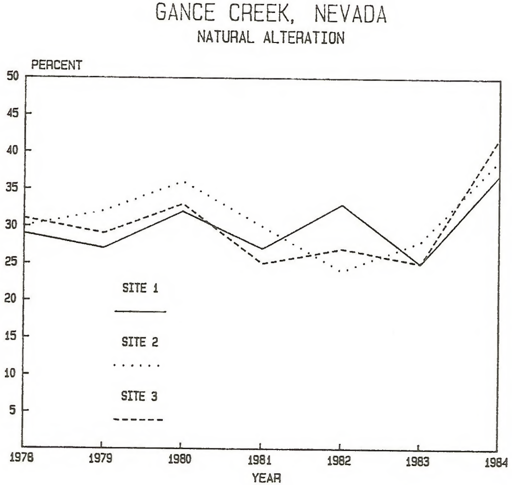


Figure 7.4. Natural streambank alteration ratings, Gance Creek study area, 1978-1984.

Stream vegetation use by livestock was the lowest encountered during our studies. Prior to 1984, grazing use in the downstream control area ranged from 42 to 75 percent, and 35 to 75 percent in the upstream control area (Table 7.4). In 1984, however, grazing use was 11 and 2 percent in the lower and upper control areas, respectively. Once again, vegetation use estimates in an adjacent riparian meadow were considerably higher at 75 to 85 percent (R. Eckert, Jr., pers. comm.). Three reasons may account for these low levels: (1) Sampling was conducted approximately 1 month after cattle were removed from the Southern Forest Service Pasture, and some regrowth may have occurred; (2) herd numbers and grazing use may have been down in 1984; and (3) due to the amount of downcutting (particularly in the grazed site 3), steeper banks with less

Table 7.4.--Summary of annual riparian means, Gance Creek, Nevada, 1978-1984.

	Habitat type	Bank cover stability	Stream cover	Bank alteration Natural (%)	Bank alteration Artificial (%)	Total	Veg. overhang (feet)	Veg. use (%)	Light intensity (%)	Solar radiation (BTU's)
Site 1										
1978	6.8	1.3	2.7	29	21	50	0.09	68	ND[1/]	ND
1979	12.1	1.9	3.0	27	14	41	0.18	73	ND	ND
1980	10.4	2.2	1.9	32	16	48	0.07	46	ND	ND
1981	12.4	2.1	2.4	27	17	44	0.15	75[2/]	ND	ND
1982	15.2	2.5	2.7	33	13	46	0.33	55	61	ND
1983	ND	2.4	2.0	25	12	37	0.18	42	71	ND
1984	ND	2.3	2.3	37	9	46	0.06	11	ND	8,033
Site 2										
1978	6.1	1.4	2.4	30	15	45	0.14	53	ND	ND
1979	7.9	1.6	2.5	32	9	41	0.12	15	ND	ND
1980	10.1	2.3	1.9	36	0	36	0.14	>0	ND	ND
1981	12.1	2.1	1.9	30	11	41	0.13	>55	ND	ND
1982	15.4	2.9	2.5	24	7	31	0.37	1	60	ND
1983	ND	2.2	1.8	28	1	29	0.18	0	56	ND
1984	ND	2.2	2.4	39	2	41	0.07	0	ND	6,941
Site 3										
1978	12.0	2.2	2.7	31	19	50	0.06	59	ND	ND
1979	8.5	1.6	2.5	29	13	42	0.08	48	ND	ND
1978	10.6	2.2	1.8	33	12	45	0.14	42	ND	ND
1981	10.8	2.0	1.9	25	15	40	0.06	75	ND	ND
1982	13.5	2.5	2.4	27	16	43	0.28	56	59	ND
1983	ND	1.9	1.8	25	8	33	0.97	35	62	ND
1984	ND	2.2	2.2	42	8	50	0.05	2	ND	7,337

[1/]ND = No data.

[2/]Data provided by Dr. Richard E. Eckert, Jr., Range Scientist, USDA-Agricultural Research Service, Renewable Resources Center, Reno, Nevada.

vegetation (indicated by bank angle, overhanging vegetation, and change in stream cover type) may have led to less evidence of cattle use. Whatever the cause, decreased impact of cattle grazing combined with major increases in natural runoff events (Platts and others, in press) prevent us from attributing changes in aquatic and riparian habitat conditions to livestock use. This conclusion is also supported by artificial streambank alteration ratings, which overall, were the lowest ever measured.

Fish Populations

Cutthroat trout populations dramatically increased in 1984 in all three sites over the previous 2 years (Table 7.5). In sites 1 and 2, the highest numbers of cutthroat trout ever recorded were found. The cyclic pattern of the Gance Creek cutthroat trout population density is well illustrated in Figure 7.5. The population may fluctuate in alternating 2-year-periods of boom and bust (Figure 7.5). After 2 years of relatively low densities in 1978 and 1979, the years 1980 and 1981 exhibited high densities. This was followed by another 2-year-low-period in 1982 and 1983. In 1984, populations, as mentioned previously, were up considerably. Standing crop and total numbers in 1984 were 3 and 3.6 times higher, respectively, in site 2 than in 1983. There was 98-percent increase in cutthroat in site 1, and an 86-percent rise in site 3. Biomass estimates also increased, however, at a much lower rate, particularly in site 2. We attribute this lower biomass rise to the age structure of the population. Much of the rise in numbers and density can be attributed to a successful young-of-the-year class throughout the area. This is evident from the decline in average length and weight of cutthroat trout in each stream section. There was evidence of increased stress and competition also, as indicated by declines in average fish condition factor in all three sites.

In contrast to 1983, when the lowest densities occurred in site 2, 1984 showed the greatest improvement in numbers and standing crop.

Nongame species showed similar increases, as sculpin populations were up considerably in all sites (Figure 7.5). Of special note was the 700-percent increase (from 2 to 16) in site 3, where only three sculpin have been collected in the entire 6 years prior to 1984. Unidentified dace were also collected for the first time in 1984, with four specimens sampled in site 3.

Summary

Extremely high runoff events within the Gance Creek drainage during 1983 and 1984 have resulted in changes in streambank and channel morphology, riparian conditions, and fisheries habitat. Habitat conditions continue to improve within the protected exclosure, to the point where the most favorable environment now exists within this stream reach. Cutthroat trout populations within this site showed tremendous improvement in 1984.

Table 7.5.--Summary of annual fish population results, Gance Creek, Nevada

	Study Site																				
	Site 1							Site 2							Site 3						
Variable	1978	1979	1980	1981	1982	1983	1984	1978	1979	1980	1981	1982	1983	1984	1978	1979	1980	1981	1982	1983	1984
Cutthroat Trout																					
Total catch (#)	32	175	303	203	183	156	325	64	184	294	288	170	102	378	110	216	472	524	126	201	376
Population estimate (#)	32	181	327	207	191	166	329	64	203	303	299	185	104	379	111	235	506	533	143	206	383
Mean length (in)	4.47	2.42	2.66	3.39	2.87	2.86	2.61	3.57	2.19	2.82	2.73	2.72	3.14	2.34	2.46	1.98	2.09	2.56	2.62	2.77	2.62
Mean weight (oz)	0.97	0.39	0.41	0.40	0.31	0.27	0.19	0.73	0.31	0.52	0.23	0.24	0.39	0.14	0.22	0.11	0.26	0.17	0.18	0.22	0.19
Estimated biomass (oz/ft^2[x10^{-2}])	1.0	2.3	3.8	2.4	1.6	1.1	1.3	1.3	1.9	4.0	1.9	1.2	1.1	1.2	0.9	0.8	3.4	2.5	0.8	1.1	1.7
Estimated standing crop (#/ft^2[x10^{-2}])	1.0	5.8	9.1	5.8	5.0	4.3	7.3	1.8	6.0	7.8	8.2	5.2	2.7	8.3	4.1	7.1	13.2	14.3	4.3	5.2	8.7
(#/mile)	282	1593	2878	1822	1681	1461	2895	563	1786	2666	2631	1628	915	3335	977	2068	4453	4690	1258	1813	3370
Population condition factor[1/]	1.0	0.8	0.9	1.0	1.4	1.3	0.8	1.0	0.8	0.9	0.9	1.4	1.1	0.8	1.0	0.7	0.9	0.9	1.4	1.0	0.9
Sculpin[2/]																					
Total catch (#)	203	17	53	37	94	43	100	1	2	5	27	29	8	24	0	1	0	0	0	2	16
Population estimate (#)	203	29	54	38	115	47	116	N.A.[3/]	N.A.	5	27	47	9	25	--	N.A.	--	--	--	2	16
Mean weight (oz)	0.05	0.20	N.D.[4/]	0.20	0.16	0.23	N.D.	0.49	0.17	N.D.	0.17	0.23	0.26	N.D.	--	0.27	--	--	--	0.39	N.D.
Observed biomass (oz/ft^2[x10^{-2}])	0.3	0.1	N.D.	0.2	0.4	0.3	N.D.	0.0	0.0	N.D.	0.1	0.2	0.05	N.D.	--	0.0	--	--	--	0.02	N.D.
Observed standing crop (#/ft^2[x10^{-2}])	6.6	0.5	1.4	1.2	2.5	1.2	2.6	0.0	0.1	0.1	0.7	1.3	0.2	0.5	--	0.0	--	--	--	0.1	0.4
(#/mile)	1786	255	475	334	827	378.4	1021	9	18	44	238	255	70	220	--	9	--	--	--	18	141
Sucker[2/]																					
Total catch (#)	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
Population estimate (#)	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--
Mean weight (oz)	--	--	--	--	--	--	--	--	0.17	--	--	--	--	--	--	--	--	--	--	--	--
Observed biomass (oz/ft^2[x10^{-2}])	--	--	--	--	--	--	--	--	0.0	--	--	--	--	--	--	--	--	--	--	--	--
Observed standing crop (#/ft^2[x10^{-2}])	--	--	--	--	--	--	--	--	0.1	--	--	--	--	--	--	--	--	--	--	--	--
(#/mile)	--	--	--	--	--	--	--	--	35	--	--	--	--	--	--	--	--	--	--	--	--
Dace																					
Total catch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	--	--	--	--	--	--	4
Population estimate	--	--	--	--	--	--	--	--	--	--	--	--		--	--	--	--	--	--	--	4
Observed standing crop (#/ft^2)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.1
(#/mile)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	35

1/ This variable had to be estimated for 1980 by pooling data for all years and is probably over estimated.

2/ Total catch figures used for biomass and standing crop determinations because nongame species frequently are not collected strictly in accordance with population estimation assumptions; population estimates are presented for consideration but should not be considered reliable.

3/ N.A. - not available; capture pattern did not fit model closely enough to obtain even a poor estimate and/or total catch was zero.

4/ N.D. - no data; nongame species were not weighted in 1980.

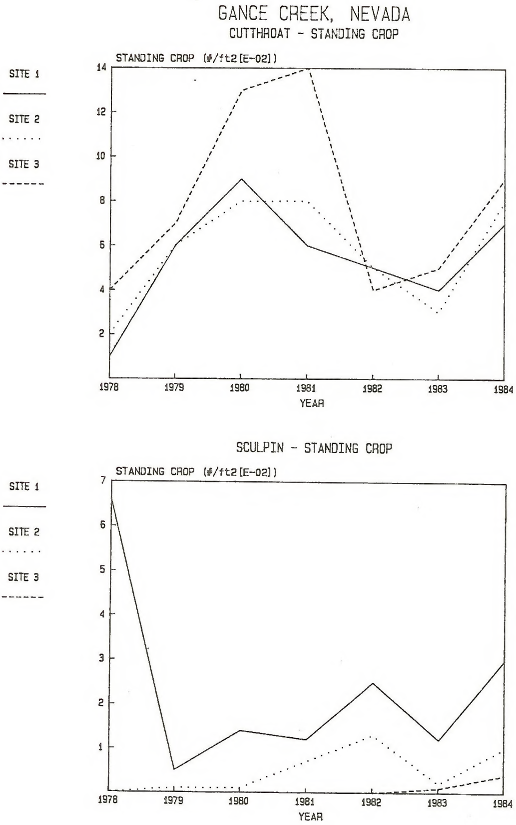


Figure 7.5. Fish density trends in the Gance Creek study area.

The combination of low cattle use in 1984, and high impacts from runoff, precludes any conclusions to be made concerning livestock influence along the study area.

Literature Cited

Platts, W. S., Ka A. Gebhardt, and W. L. Jackson. In Press. The Effects of Large Storm Events on Basin-Range Riparian and Stream Habitats. North Amer. Riparian Conf., Tucson, AZ. April 16-18, 1985.

Platts, W. S., and R. L. Nelson. 1983. Livestock-Fishery Interaction Studies - Gance Creek, Nevada, Progress Report 5. Unpubl. report of file, USDA Forest Service, Intermt. For. and Range Exp. Stn., For. Sci. Lab., Boise, ID. 139 p.

CHAPTER 8

LIVESTOCK RESEARCH

Part 1: CATTLE BEHAVIOR

Julie L. Morrow and David E. Brown

1984 Objectives:

1. Gain an understanding of cattle grazing strategies under a deferred rotation management plan.

2. Continue observational study of cattle distributions and patterns of animal activity.

3. Analyze 1983 and 1984 data to determine the influence of environmental and physical factors on cattle distribution and activity.

1984 Accomplishments:

Data were collected at the top of Mahala Creek in the South Forest Service pasture during the late grazing season. These data are being compared to the data collected on the same site in 1983 during the early grazing season. Animal location, identity, and activity were recorded on topographic maps at half hour intervals from sunrise to sunset two consecutive days a week. Observations taken at half hour intervals give reasonably accurate estimates for activities of longer duration, such as grazing and ruminating, but gives questionable reliability for short duration activities such as walking, nursing, drinking, and fighting (Hull et al., 1960; Nelson and Furr, 1966). Licking salt is intermediate between the short and long duration activities since cattle may monopolize a block of salt (Culley, 1938).

Animal activities included lying down, standing idle, foraging, drinking, moving, nursing, grooming, licking salt, and fighting. Cows and their calves made up the majority of the study population. This year steers grazed in the allotment which presented some difficulty in determining animal identities. Deer observations were also recorded. The study site was divided into 193 one hectare cells. Slope, aspect, elevation, and major vegetation types (from black/white and color infrared aerial photos) were determined for each cell.

The number of animals sighted during the 1983 and 1984 grazing seasons were similar, 4218 and 4405 respectively. However, the distributions throughout the grazing seasons were very different. The variation between days in the 1983 season was due to movement of animals in and out of the study area but the number of animals observed per week remained constant (Fig. 8.1). In 1984 a very different pattern of animal presence in the area was seen. Due to the movement of animals by the ranch into the South Forest Service allotment, a significant number of animals was seen during the first week of the study. Animals had access to both BLM pastures and

the North Forest Service throughout the six week grazing period. Thus, the cattle tended to drift into these other areas out of the South Forest Service and fewer animals were observed in the study area as the season progressed (Fig. 8.2).

Significant periodicity in the number of animals observed throughout the day was seen during the 1983 early grazing season (Fig. 8.3) while a more equal distribution of activity level was shown in 1984 during the late grazing season (Fig. 8.4). The statistical analysis to determine whether this animal observability reflects a pattern in the time spent grazing has not been completed. In a similar study of moose in Fairbanks, Alaska, Linkswiler (1982) also found that moose activity levels were most uniform throughout the day during mid- and late summer. From early to late summer Linkswiler noted a flattening of the activity curves. Activity levels in the moose study were highest morning and evening, but sharp peaks were not apparent after early summer.

A vegetation map of the study area was prepared by M. Barrington (Fig. 8.5).

Literature Cited

Culley, M. J. 1983. Grazing habits of range cattle. J. Forest. 36:715-717.

Hull, J. L., G. P. Lofgreen, and J. H. Meyer. 1960. Continuous versus intermittent observations in behavior studies with grazing cattle. J. Anim. Sci. 19:1204-1207.

Linkswiler, C. 1982. Factors influencing behavior and sightability of moose in Denali National Park, Alaska. M.S. Thesis, Univ. Alaska, Fairbanks.

Nelson, A. B. and R. D. Furr. 1966. Interval of observation of grazing habits of range beef cows. J. Range Manage. 19:26-29.

Editor's Note:

Since this chapter was prepared, Julie Morrow has successfully completed her M.S. program. Her thesis, "Factors Affecting Spatial Behavior and Activity Patterns of Cattle on a Mountain Big Sagebrush Site," has been approved and is available on loan from the University of Nevada, Reno, library. Copies have been distributed to cooperators and other interested parties. A limited number of additional copies are available from the Editor/Project Manager.

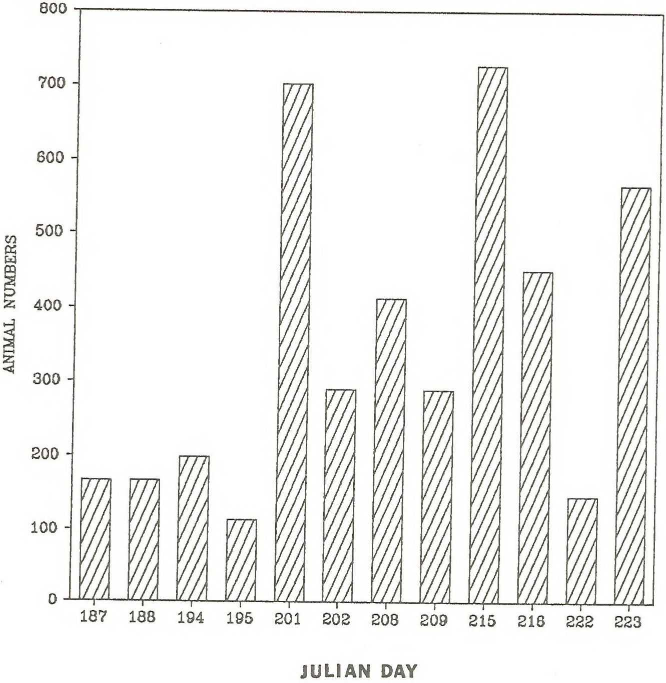


Fig. 8.1. Number of cattle observed on upper Mahala Creek site during 1983 grazing season.

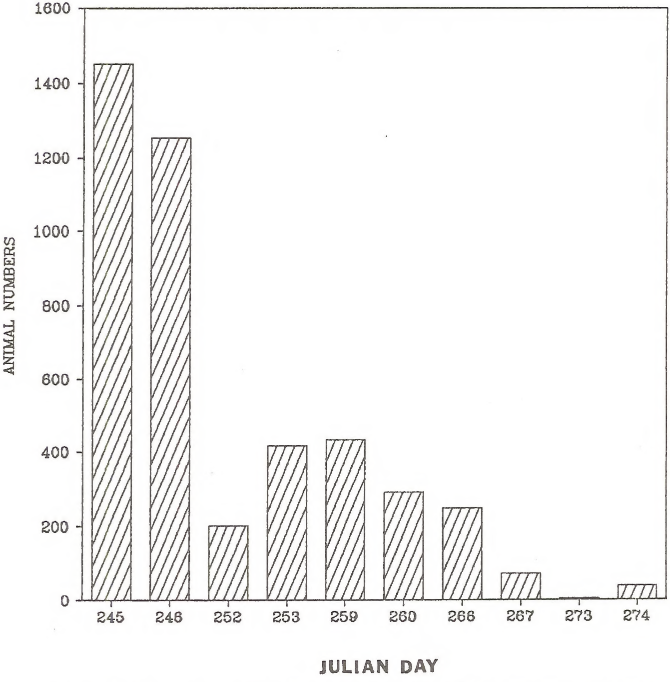


Fig. 8.2. The number of animals observed on upper Mahala Creek site during 1984 grazing season.

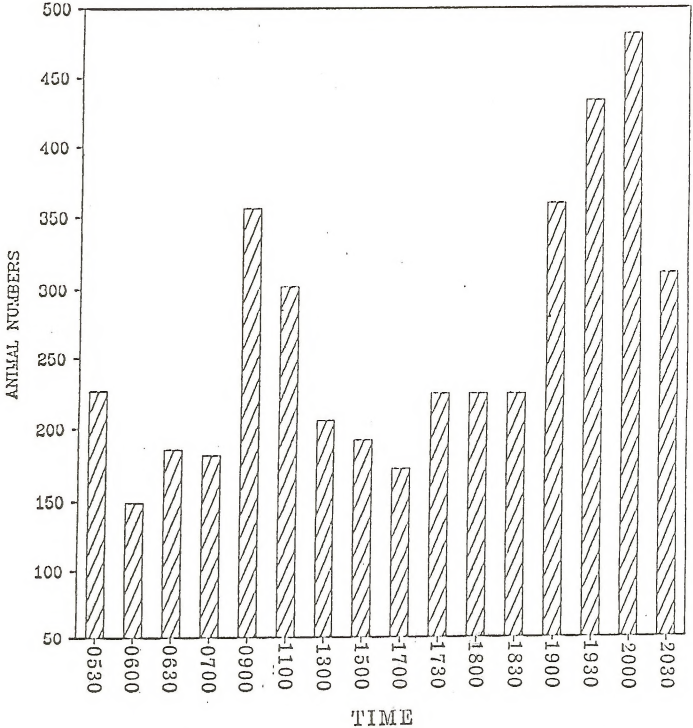


Fig. 8.3. The diurnal distribution of the number of animals observed on upper Mahala Creek during the 1983 grazing season.

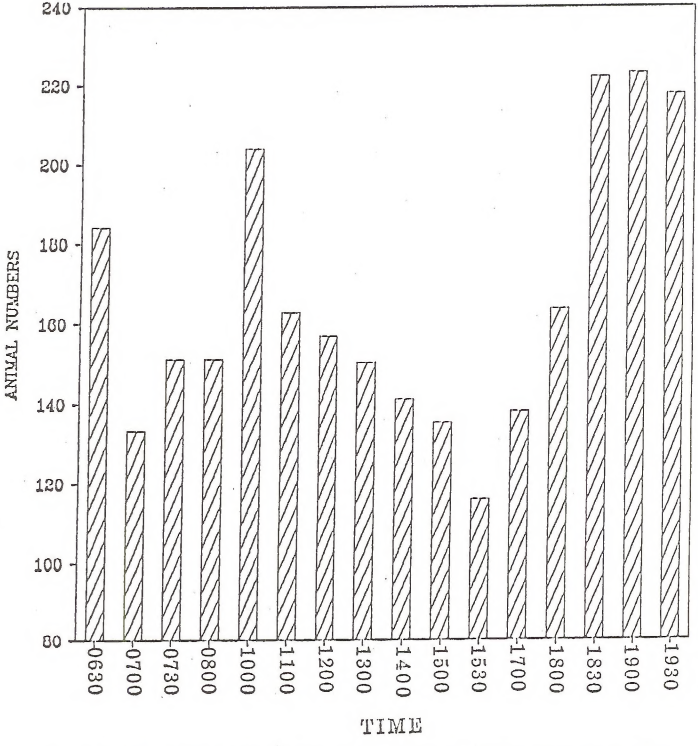


Fig. 8.4. The diurnal distribution of the number of animals observed on upper Mahala Creek during the 1984 late grazing season.

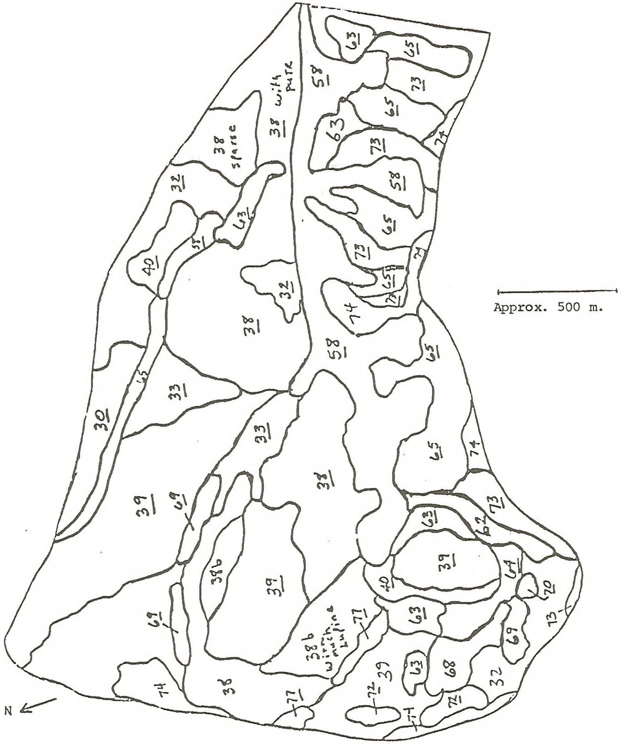


Fig. 8.5. Vegetation map of upper Mahala Creek study site.
(See page 107 for legend.)

VEGETATION CLASSIFICATION CODES ON THE UPPER MAHALA CREEK STUDY SITE *

30	mountain big sagebrush/antelope bitterbrush/low rabbitbrush
32	mountain big sagebrush/antelope bitterbrush/low rabbitbrush/ utah serviceberry
33	mountain big sagebrush/mountain snowberry/antelope bitterbrush/ low rabbitbrush/utah serviceberry
38	mountain big sagebrush/great basin wildrye/tailcup lupine
39	mountain big sagebrush/antelope bitterbrush/rubber rabbitbrush/ grass
40	mountain big sagebrush/mountain snowberry/grass
58	riparian aspen woodland with meadow
62	aspen thicket (dense)
63	aspen thicket (less dense)
64	aspen/willow thicket
65	aspen/chokecherry thicket
68	chokecherry/aspen/grass
69	willow/grass (seeps)
70	snowbrush/mountain big sagebrush/grass
72	letterman needlegrass/tailcup lupine (snow pocket)
73	low sagebrush/idaho fescue/bluebunch wheatgrass
74	low sagebrush/bluegrass (ridge tops)

* Classification by M. Barrington.

Legend for Fig. 8.5.

Part 2: CATTLE NUTRITION AND PRODUCTION

V. R. Bohman, Ron Torell and Stephen Poole

Cattle were maintained on the Saval Ranch according to the following schedule in 1984.

1 January to 1 April - On native meadows (private) with winter feeding program.

1 April to 30 May 1984 - On crested wheatgrass (Sheep Creek seeding, 15 days; East Darling, 15 days).

30 May to 9 July 1984 - On BLM native range (Upper Mahala, 20 days; Upper Sheep Creek, 20 days).

9 July to 31 October 1984 - On Forest Service native range (North Pasture, 40 days; South Pasture, 45 days).

31 October to 3-7 December 1984 - On crested wheatgrass (East Darling pasture).

Representative yearling and mature cattle were weighed and blood samples taken 31 May and 9-10 July. Yearlings were again weighed and sampled 31 October and cows were weighed and sampled 15 December. Yearlings (n = 34) gained most rapidly while grazing BLM native range in the spring (average initial weight, 5/23,433 lbs and daily gain 5/23 to 7/10,1.96 lbs/day for 48 days). The gains were not as rapid on the Forest Service pastures (n = 25; average initial weight 536 lbs and daily gain 1.03 lbs/day from 7/10 to 10/31; 114 days). Different plant species and stage of plant maturity were involved. For the entire period (5/23 to 10/31,162 days; n = 37); the average daily gain was 1.43 lbs/day. In contrast, stocker cattle from California placed on the native meadows and private crested wheatgrass pasture gained 1.04 lbs/day. The California cattle were in better flesh initially and consequently the local cattle exhibited compensatory gains and thus responded better on these range pastures. Other factors may have played a role, but their effects were not measured or obvious.

The mature cattle (cows) were lightest initially, 5/23,(814 lbs) and gained weight most rapidly during the following 48 days while grazing BLM native pastures (1.62 lbs/day). During the subsequent period, 7/10 to 12/15, they maintained their weight (-.15 lb ADG for 159 days). The light initial weight reflected several items: First, most of the calves were born just prior to the initial measurement (see below):

Calf births by periods - 1984

3/1 to 5/30	- 370 calves born
6/1 to 7/9	- 41 calves born
7/9 to 12/15	- 15 calves born
	426 head born

In addition, the 1983-1984 winter was severe and many animals died of malnutrition. For example, 721 animals were counted in the fall of 1983. In the fall of 1984, only 601 were tallied. No animals were known to have been sold or moved from the range during this interval. Obviously, the mature cattle had not recovered their weight at the time of the first sampling. If the 426 is an accurate measure of calves born in 1984, the calving percentage was 426/601 X 100 = 71%. In contrast, when the cows were pregnancy tested by Ralph Vance, 12/84, 86% of the cows were pregnant. The stocker animals weighed 695 lbs for the steers and 565 lbs for the heifers on 10 December 1984.

Preliminary data on the composition of the blood of the cattle indicates the following: The animals were not anemic; the hematocrit was in the normal range when sampled. The blood urea nitrogen (BUN) varied with the expected content of the forage and was similar between classes of cattle. The levels of calcium, magnesium and phosphorus appear to be adequate and normal. Half of the cattle measured had levels of plasma copper less than 0.65 µg/ml. This level is considered to be the minimum level that is adequate for cattle. The levels of plasma zinc seemed to be borderline. The data on the nutritional evaluation of the status of grazing animals is not complete, but is interesting nevertheless and indicates some nutritional problems. Additional data are being obtained and evaluated.

CHAPTER 9

DATA MANAGEMENT AND REMOTE SENSING

In conjunction with a BLM Denver Service Center project and interagency agreement with the Environmental Protection Agency (EPA), some excellent color infrared aerial photography was obtained for selected riparian areas on the Saval Allotment.

To date only a crude cover area analysis has been undertaken from these 1:2,000 nominal scale color photos. The results are shown in Table 9.1. The three vegetation categories, trees, brush and herbs (grasses), as well as bare ground and water, have been mapped on mylar overlays by D. R. Williams of Lockheed Engineering and Management Services, an EPA contractor.

Further efforts are planned to test the value of this imagery for monitoring change and as a tool for wildlife habitat mapping.

Plans for remote sensing work in summer of 1985 include a repeat of low level aerial photography taken from a Bell B1 helicopter in 1981. Analysis of the imagery, to be undertaken by Dr. Paul Tueller, UNR, will provide a test of the efficacy of such aerial photography for vegetation monitoring.

Data from vegetation monitoring plots in the East Darling (EDS), West Darling (WDS), Darling Control (DC), Lower Sheep Creek (LSC), Lower Mahala Creek (LMC), Middle Mahala Creek (MMC) and Mahala Control (MC) pastures have been stored on BLM's Denver Service Center Honeywell (DPS8) System. Data lines consist of a sampling date, X and Y grid coordinates, a monitoring plot identification number, a range site code and name, a coded species name or ground cover type, and data values specific to the type of data in the file (i.e., frequency of occurrence, ground cover, canopy cover or density). Each type of data is stored under a specific catalog by pasture. For example, species frequency data for the East Darling Pasture is stored in file "EDS" in the subcatalog "FREQ." All data files are designed for use with the ASPEN/2 data base management system. Files will be stored on removable disk packs when not in use.

Subcatalogs for vegetation data will be:

Subcatalog	Data Type
FREQ	Species frequency of occurrence
GRCOV	Ground cover
TSCOV	Tree and shrub canopy cover
TSDENS	Tree and shrub age class densities
UTILIZ	Yearly utilization records
PHENOL	Yearly species phenology records
PROD	Yearly species production

Some precipitation data files are also available on the BLM's DPS8, as a result of the effort underway to integrate these stations with Nevada Watershed Studies. Other climatological and hydrological data, computer system and access are described in chapters 1 and 2.

Mule deer observations and livestock behavior observations are now stored in DPS8 data files in time-sharing. Progress has been made in preparing non-game wildlife data for entry and beginning entry.

In each case, any party interested in the data should be careful to consult the appropriate specialists prior to accessing and any potential use.

Table 9.1. Length of streams covered in aerial photography and aerial extent of three mapped vegetation categories.

Creek Name	Creek Length (Miles)	Riparian Vegetation type (acres) Trees	Brush (Shrubs)	Herbs/Grasses	Total
Sheep/Stamp	2.92	5.92	2.28	1.90	6.39
Mahala	3.04	2.17	3.46	2.89	8.50
Up. Jim	1.87	3.42	1.79	0.89	6.10
Low. Jim	2.02	--	0.16	4.95	5.12
Gance	3.14	1.74	30.78	8.00	40.50

APPENDIX I

SAVAL PROJECT

MINUTES

SECOND EXECUTIVE COMMITTEE MEETING

October 29, 1984.

Present: Dr. R. Duane Lloyd
Dean Bernard M. Jones
Dr. Jan van Schilfgaarde
Mr. Edward Spang, Chairman
Mr. Gerald Thola

Dr. Peter C. Lent, Project Manager

Observers: Dr. R. Eckert
Dr. G. F. Gifford
Dr. K. Koong
Dr. P. van Schaik
Mr. David Tidwell
Mr. Henri Bisson

Absent: Mrs. Jeanne Edwards

1. The concept of an ad hoc advisory committee was adopted. The composition and direction for the group should be generally as agreed to in the document prepared in February, 1984. The question of whether and how committee members might be reimbursed for travel costs would be addressed later through individual consultations. It must also be made clear what is to be expected of these advisory group participants. It was agreed to postpone a decision on whether the project was ready for a major demonstration, site visit and related presentations in the summer of 1985. Other major issues facing the Committee needed to be resolved first.

2. No further action would be taken to seek special agency land designations for the Saval Project research area. The threat of mining operation in the Gance Creek drainage seemed to have subsided.

3. Dean Jones presented conclusions regarding the cost of performing the research at a publicly-owned facility. It was concluded that the cost of maintaining an equivalent ranch in the public sector for research purposes would cost $200,000 to $300,000 a year.

4. After lengthy discussion it was concluded that major questions and issues regarding the future of the project could not be resolved without a meeting with the ranch owners. The Chairman agreed to send a letter to Dr. Edwards inviting him and the Ranch Manager to meet with representatives of the Executive Committee.

5. The publication accomplishments of the project were discussed. The need to begin producing high quality, technically reviewed publications was again stressed.

6. It was moved, seconded, and unanimously agreed that the duties and responsibilities of the Project Manager and the Principal Scientist, as described in the Memorandum of Understanding (MOU), be combined in a single position. This position would be occupied by the present Project Manager.

The ARS scientist position described in the MOU would continue responsibility for vegetation-related research and would have the same responsibilities as all other members of the scientific team to support and cooperate in meeting the interdisciplinary objectives of the project. An amendment to the MOU reflecting these decisions would be circulated for signature. It was emphasized that all parties continued their strong commitment to making the project truly interdisciplinary.

SAVAL PROJECT

MINUTES

THIRD EXECUTIVE COMMITTEE MEETING

January 8, 1985

Members Present:	Dr. R. Duane Lloyd Dean Bernard M. Jones Dr. Jan van Schilfgaarde Mr. Edward Spang, Chairman Mr. Gerald Thola	Others present:	Mr. D. Tidwell Mr. R. Vance Dr. G.F. Gifford Dr. R. Eckert Mr. R. Harris
	Dr. Peter C. Lent, Project Manager		
Absent:	Dr. or Mrs. Greer Edwards		

The meeting of the Saval Executive Committee was called on January 8, 1985 principally to deal with issues that had been left unresolved at the meeting of October 29, 1984.

The minutes of the October 29 meeting were approved.

At the start D. Tidwell informed the committee that he had been again assured by Dr. Edwards that they were fully committed to the success of the Saval Research Project. It was stressed, however, that the resources that they could personally commit to the project were definitely limited. Priority must be given to meeting obligations as permittee and under the Allotment Management Plan. Others stressed that the research design was also based upon careful adherance to the grazing plan.

It was concluded that the major problem area in ranch operations was the poor condition of fences. This was resulting in livestock frequently moving in significant numbers into pastures that were supposed to be being rested, etc. and jeopardizing the validity and credibility of much of the research effort.

R. Vance expressed the belief that with regard to fences from the FS/BLM boundary on down it was feasible to make the repairs necessary to keep the livestock under better control in 1985. Although no materials were presently on hand relatively little would be needed for these repairs. A few places on the FS/BLM boundary fence are in need of major overhaul.

At a recent meeting between FS personnel and Ranch Manager the FS stated that fences (above the BLM/FS boundary fence) would have to be improved before cattle were put on in 1985.

R. Vance believes the biggest problem to both good range management and the research lies with the FS perimeter fencing. Fence conditions are not satisfactory to hold livestock from drifting on the Saval Allotment. Drift is natural this direction because of the topography, etc.

All parties need to insure proper maintenance of their portion of the perimeter fence. The sections of shared fence that are Saval maintenance responsibility are in need of considerable maintenance.

The division fence between N and S Independence FS pastures continues to present problems even though some work was done on it in 1984. This is also critical to the research effort as at present the deferred rotation system is not truly in effect. There is too much uncontrolled movement of cattle between FS pastures.

The UNR Animal Science Research Associate position will be refilled this spring. The position description has been modified to put more emphasis on cooperation with ranch personnel and on observatiion of cattle behavior and distribution. This modification more properly describes the position responsibilities required for the research in handling livestock, and assuring that cattle were where they belonged, etc., in cooperation with the ranch operations.

The above action, together with the fact that the ranch may be putting less emphasis on summer haying, should help ranch personnel to find more time for fence maintenance work.

The tentative conclusion of the group was that the ranch did not seem to have the resources available at present to deal with fencing problems on FS pastures. Nevertheless, remedies for these problems are essential if the research is to continue and is to have credibility.

It was agreed that R. Harris and D. Lloyd would meet with R. Graves, Humboldt National Forest Supervisor, to explore possible solutions to the dilemma.

There might be possibilities for reconstruction funds, prisoner labor assistance, etc. There might also be some relief possible if the Saval's responsibilites for perimeter fencing were truly not equitable.

After the results of the above discussion were available D. Tidwell would speak to Dr. Edwards on behalf of the committee. Specific commitments should be sought.

Subsequently, the Operation Team would meet in Elko to develop a detailed action plan for fence work and for livestock handling well in advance of the grazing season. The Ranch will need to take the initiative this spring and start work on the lower pastures to keep ahead of the grazing sequence.

The project scientific personnel would also go ahead with their meeting on January 15-16. They should explore any research design alternatives that might enhance project's capabilities to achieve the original objectives.

Amendment No. 1 to the Saval MOU, deleting reference to a Principal Scientist position and assigning those responsibilities to the Project Manager, was approved.

It was agreed to hold the next meeting of the Executive Committee on July 9-10, 1985, in Elko. The first day would be devoted to a field trip on the Ranch. This would be principally a review of the progress and accomplishments of the research. It would also provide an opportunity to assess the success of measures to improve control of the livestock.

APPENDIX II

Symbol and scientific and common names for plant species reported in current or past reports

SYMBOL	SCIENTIFIC NAME	COMMON NAME
	Tree and Shrub Species	
AMELA	*Amelanchier spp.*	Serviceberry
AMUT	*A. utahensis*	Utah serviceberry
ARTEM	*Artemisia spp.*	Sagebrush
ARLO	*A. longiloba*	Alkali sagebrush (early, low)
ARTR	*A. tridentata*	Big sagebrush
ARTRT	*A. tridentata tridentata*	Basin big sagebrush
ARTRV	*A. tridentata vaseyana*	Mountain big sagebrush
ARTRW	*A. tridentata wyomingensis*	Wyoming big sagebrush
CELA	*Ceratoides lanata*	Common winterfat
CHRYS	*Chrysothamnus spp.*	Rabbitbrush
CHNA	*C. nauseosus*	Rubber rabbitbrush
CHVI	*C. viscidiflorus*	Low Rabbitbrush
PRVI	*Prunus virginiana*	Chokecherry
PURSH	*Purshia spp.*	Bitterbrush
PUTR	*Purshia tridentata*	Antelope bitterbrush
RIBES	*Ribes spp.*	Currant, Gooseberry
RICE	*R. cereum*	Current bush
ROSE	*Rosa spp.*	Rose
SALIX	*Salix spp.*	Willow
SYMPH	*Symphoricarpos spp.*	Snowberry
TECA	*Tetradymia canescens*	Gray horsebrush
	Forb species	
ACLA	*Achillea lanulosa*	Yarrow
ALLIU	*Allium spp.*	Wild onion
ASSC	*Aster scopulorum*	Crag aster
BORAG	Boraginaceae	Borage family
CASTI	*Castilleja spp.*	Paintbrush
CHEVO	*Chenopodium spp.*	Pigweed
COLLO	*Collomia spp.*	Collomia
COMPO	Asteraceae	Composite Family
COPA	*Collinsia parviflora*	Little flower collinsia
CRAC	*Crepis acuminata*	Tapertip hawksbeard
DESCU	*Descurainia spp.*	Tansy mustard
ERIOG	*Eriogonum spp.*	Wild buckwheat
FRAGA	*Fragaria spp.*	Strawberry
GABI	*Galium bifolium*	Bedstraw
HACKE	*Hackelia spp.*	Stickweed
HYCA	*Hydrophyllum capitatum*	Cow cabbage, waterleaf
IVAX	*Iva axillaris*	Poverty sumpweed
LODI	*Lomatium dissectum*	Carrotleaf lomatium
LVCA	*Lupinus caudatus*	Tailcup Lupine

SYMBOL	SCIENTIFIC NAME	COMMON NAME
MESA	*Medicago sativa*	Ladak alfalfa
MEOF	*Melilotus officinalis*	Yellow sweetclover
MECI	*Mertensia ciliata*	Shortstyle bluebell
NAVAR	*Navarretia spp.*	Navarretia
PABR	*Paeonia brownii*	Peony
PHHO	*Phlox hoodii*	Hoods phlox
PHLO	*P. longifolia*	Longleaf phlox
PHORA	*Phoradendron spp.*	Mistletoe
PLANT	*Plantago spp.*	Plantain
POBI	*Polygonum bistortoides*	American bistort
POTEN	*Potentialla spp.*	Cinquefoil
SAMI	*Sanguisorba minor*	Small burnet
SMST	*Smilacina stellata*	Starry false solomon-seal
SPHAE	*Sphaeralcea spp.*	Globe mallow
STACH	*Stachys spp.*	Hedge nettle
VIOLA	*Viola spp.*	Violet
WYAN	*Wyethia amplexicaulis*	Mulesear wyethia
	Grass and grass-like species	
AGROP	*Agropyron spp.*	Wheatgrass
AGDE	*Agropryon desertorum*	Crested wheatgrass (Nordan)
AGSP	*A. spicatum*	Bluebunch Wheatgrass
AGTRY	*A. trachycaulum*	Slender wheatgrass
BROMU	*Bromus spp.*	Brome
BRCA	*B. carinatus*	Mountain brome
BRTE	*B. tectorum*	Cheatgrass brome
CAREX	*Carex spp.*	Sedge
ELEOC	*Eleochoris spp.*	Spikerush
ELYMU	*Elymus spp.*	Wildrye
ELCI	*E. cinereus*	Great basin wildrye
ELJU	*E. junceus*	Russian wildrye
FEID	*Festuca idahoensis*	Idaho fescue
HEKI	*Hesperocloa kingii*	Spike fescue
JUNCU	*Juncus spp.*	Rush
MUHLE	*Muhlenbergia spp.*	Muhly
MURI	*M. richardsonis*	Mat muhly
ORWE	*Oryzopsis webberi*	Webber ricegrass
POA	*Poa spp.*	Bluegrass
PONE	*P. nevadensis*	Nevada bluegrass
POPR	*P. pratensis*	Kentucky bluegrass
POSA	*P. sandbergii*	Sandberg bluegrass
SIHY	*Sitanion hystrix*	Bottlebrush squirreltail
STIPA	*Stipa spp.*	Needlegrass
STTH	*S. thurberiana*	Thurber needlegrass
AGTR2	*Agropyron trichophorum*	Pubescent wheatgrass
BRMA	*Bromus marginatus*	Big mountain brome
MEBU	*Melica bulbosa*	Oniongrass
ORHYH	*Oryzopsis hymenoides*	Indian ricegrass

Wildlife species reported from the ranch

MAMMALS

SCIENTIFIC NAME	COMMON NAME
Odocoileus hemionus	Mule deer
Antilocapra americana	Pronghorn antelope
Canis latrans	Coyote
Sorex merriami	Merriam shrew
S. palustris	Northern water shrew
Lepus californicus	Black-tailed jackrabbit
Lagurus curtatus	Sagebrush vole
Microtus montanus	Mountain vole
Onychomys leucogaster	Northern grasshopper mouse
Peromyscus maniculatus	Deer mouse
Perognathus parvus	Great Basin pocket mouse
Eutamius minimus	Least chipmunk

BIRDS

Branta canadensis	Canada goose
Anas platyrhynchos	Mallard
Anas acuta	Pintail
Anas strepera	Gadwall
Anas cyanoptera	Cinnamon teal
Anas carolinensis	Green-winged teal
Aythya americana	Redhead
Aythya affinis	Lesser scaup
Centrocercus urophasianus	Sage grouse
Steganopus tricolor	Wilson's phalarope
Zenaida macroura	Mourning dove
Eremopila alpestris	Horned lark
Amphispiza belli	Sage sparrow
Chondestes grammacus	Lark sparrow
Melospiza melodia	Song sparrow
Passerina amoena	Lazuli bunting
Passerella iliaca	Fox sparrow
Pipilo chlorurus	Green-tailed towhee
Pipilo erythrophthalmus	Rufous-sided towhee
Pooecetes gramineus	Vesper sparrow
Spizella breweri	Brewer's sparrow
Zonotrichia leucophrys	White-crowned sparrow
Sturnella neglecta	Western meadowlark
Oreoscoptes montanus	Sage thrasher
Dendroica petechia	Yellow warbler
Troglodytes aedon	House wren
Turdus migratorius	American robin
Empidonax spp.	Empidonax flycatcher
Vireo gilvus	Warbling vireo
Colaptes cafer	Common flicker
Speotyto cunicularia	Burrowing owl
Podiceps caspicus	Eared grebe
E. wrightii	Gray flycatcher

FISH

Salmo clarki (*S. c. henshawi?*)	Humboldt (Lahontan) cutthroat trout

APPENDIX III

CONVERSION TABLE: ENGLISH TO METRIC UNITS

To Convert	Into:	Multiply by:
Acres	Hectares	.4047
Feet	Meters	.3048
Inches	Centimeters	2.5400
Miles	Kilometers	1.6090
Number/square mile	Number/square kilometer	.3863
Pounds	Grams	453.5924
Pounds	Kilograms	.4536
Pounds/acre	Grams/hectare	1120.8115
Pounds/acre	Kilograms/hectare	1.1208
Square feet	Square meters	.0929
Square yards	Square meters	.8361
Temperature (°F) -32	Temperature (C)	5/9
Yards	Meters	.9144
Cubic feet/second	Cubic meter/second	.0283
Cubic feet/second/square mile	Cubic meter/second/square kilometer	.0109